# POWER

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# Ignorance or Politics?

Rochester, Minnesota has a municipal light plant. It also has a natural-gas distribution service and an enterprising mayor who is said to have congressional aspirations.

One of the two boilers in the power house is equipped to burn natural gas and the other coal. The latter part of February a three-day power show was held, under the mayor's leadership, the big event being a widely proclaimed competitive test of the two fuels. Members of the Minnesota League of Municipal Electrical Utilities and guests were there, more than a thousand strong.

Preparations and apparatus for the test were palpably inadequate and men connected with the show made this well known to the audience in advance. But later, rumors circulated about an efficiency of 85.3 per cent that was obtained from the coal-burning boiler. The gas people are reported to have said that their results will be seen at the end of a year's time, when all costs of gas burning will be balanced against the useful boiler output.

The "opéra bouffe" aspect of the whole affair was evident from the beginning, and the engineering profession is not pleased with the entire performance.

It is too bad engineers were drawn into the demonstration, since it has brought no reliable conclusion but that engineering *per se* and politics do not mix.

# EDITORIALS

## Blundering Through

Of the many irrational proposals coming out of the attempt of Congress to increase revenue, none is more short-sighted than the imposition of a heavy import duty on coal under the guise of a tax. Our exports of coal are about fifty times the imports and Canada is a large customer.

This proposal comes at a time when the British Empire gives indication of going protectionist and plans to forward Empire preference are being formulated for presentation at the Imperial Conference to be held in Ottawa during July. If Welch anthracite is shut out of the United States by a prohibitive import tax, Canada is likely to retaliate by substituting a heavy tax in place of her present preferential duty on American coal, and turn to the importation of British coal for her supply.

Individual groups within industries are taking advantage of the chaotic conditions at Washington to urge preferential treatment in their own interests. Our bituminous coal industry has long been in a bad way. Its domestic market is curtailed through the depression and competition from oil and gas, and an unhampered export trade for its surplus is far more important than an excise tax on the small amount of foreign coal that comes into this country.

Coal users have a common interest with producers in promoting stability in the coal industry and will look with disfavor upon any disrupting influence, especially at this time.

## Motor Mistakes Are Expensive

One needs only consider the large number of motor and control installations in which changes have been necessary to obtain satisfactory operation, to realize that poor engineering is too prevalent. The requirements of some drives are difficult to predict, but even when due allowance is made there remain many misfit installations which could have been avoided if available information had been properly used. A small investment in good engineering before an installation is made will pay large returns in reduced equipment cost, decreased maintenance expense and increased production. In addition, expensive changes in equipment, after the installation has been completed and gone into service, are avoided.

Overmotoring is one of the most common mistakes, and is frequently an expensive one. Not only is the cost of the equipment higher and its efficiency lower, but where induction motors are involved their power factor is poor. When power is purchased the rates are usually higher for a low-power-factor load than where it is near unity. In such cases, overmotoring is doubly expensive and may necessitate the installation of corrective equipment. Using induction motors for drives where a synchronous type is better suited is another common mistake. Many loads allow a combination of synchronous and induction motors that gives a high power factor, improves efficiency and reduces power cost.

Mistakes in motor applications are not confined to those mentioned, but include the use of equipment unsuited to the drive, overloading and other improper practices. Whatever forms the errors may take, they generally prove costly in operation.

## Refrigeration Pipe Flange Standard

An article in this issue on refrigeration piping contains the statement that flange fittings of one company are not interchangeable with those of similar types made by other manufacturers. Although at present the refrigeration industry has no standard for pipe flanges, nevertheless four years of effort by the American Standards Association with the cooperation of the manufacturers and the American Society of Refrigerating Engineers has resulted in a proposed standard for the class of equipment that is nearly ready for adoption.

Adoption of these standards will make possible a considerable saving to plant operators by reducing the number of types of valves and fittings. It will enable engineers in the future to use valves or other parts especially suited to actual conditions instead of being more or less forced to replace them with parts exactly the same as before, simply because the flanges of other makes would not fit.

Although a flange standard will cause manufacturers to give up many of their individual flange designs, it should in other ways, react to their benefit, as it will remove the necessity of discussing with the prospective purchaser the merits of his particular flange design and allow for concentration upon the more important features of his equipment.

The refrigeration industry is urged to promote the adoption of the pending flange standards as early as possible.

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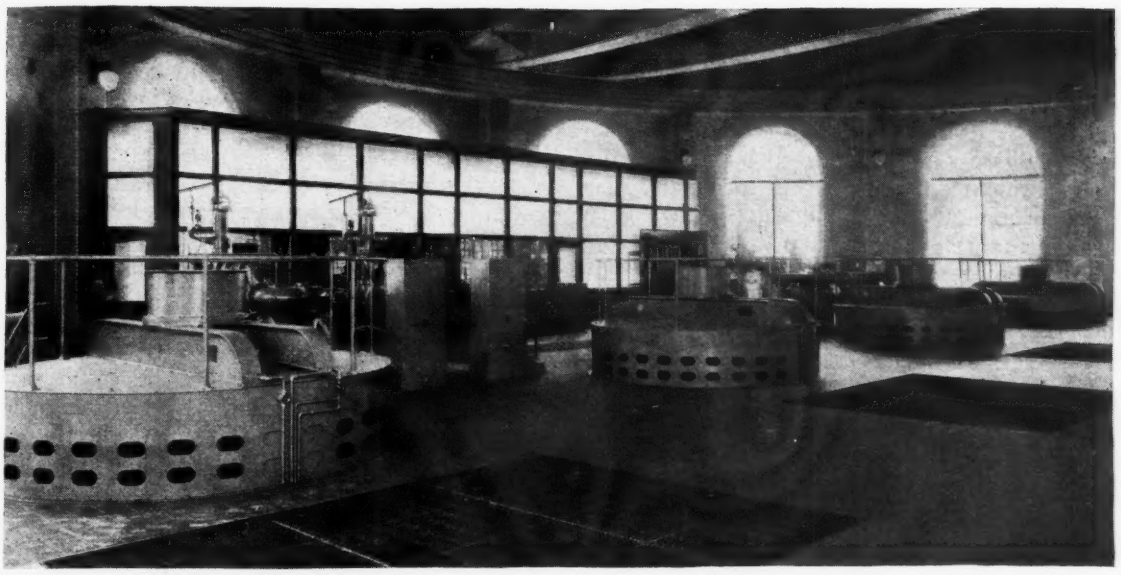
## POWER Stands for . .

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason



**Each of the four pumps is driven by a 2,300-hp. 4,600-volt full-voltage-start synchronous motor**

# Large Storm-Water Pumps Have Siphon Discharges

By LOUIS E. AYRES and GEORGE E. LEWIS

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In the Connors Creek storm-water pumping station of the city of Detroit the four 225,000-g.p.m. pumps are driven by 2,300-hp., 4,600-volt, full-voltage starting synchronous motors. When selecting this equipment exhaustive engineering studies were made and models of the pumping units tested. After installation the units were tested in place; the results of this work are given in the article

THE NEW Connors Creek storm-water pumping station, at the corner of Jefferson and Clairepointe Avenues, Detroit, Mich., has four large pumping units that embody several interesting features in their design. These pumps, recently put into operation, serve to transfer storm flow from about 2,733 acres of eastern Detroit, delivered by two 14-ft. diameter incoming relief tunnels, into the adjacent Connors Creek storm-water outlet, from whence it flows to the Detroit River. They are installed in a circular station having an inside diameter of 100 ft. and designed to house, eventually, a total of eight units. Each of the present units consists of an 84-in. vertical pump with a capacity of 500 sec-ft. (225,000 g.p.m.) against a head of 27 ft., direct-connected to a 2,300-hp. synchronous motor. The present installed capacity is, therefore, 2,000 sec.-ft. and the anticipated ultimate of the station 4,000 second-feet.

## Siphon Settings and Priming

Probably the two most interesting features of these pumps are the siphon discharges and the method of priming. Siphons were first considered to avoid the use of large valves. Although experience with a 72-in. valve had been satisfactory, in a comparable installation in Detroit, in this instance valves at least as large as 96 in. would have been required. And it developed after the pumps were purchased that valves, on the discharge side at least, were quite undesirable, as the pump characteristics were such that the horsepower increased with a decrease in quantity delivered, so that a closed valve or a considerably throttled valve could not be permitted when the pump was in operation. The use of a valve, therefore, to control backflow would have required a nice timing of its opening and closing to synchronize with the stopping or starting of the pump, otherwise overloading of the motor would result. The siphon design obviated this difficulty, but the size of siphon required was large and the height, as usually designed, made it cumbersome. It was to overcome this latter feature that the lower siphon and unusual method of priming were developed and adopted.

In Fig. 1 is shown a cross-section of a pump suction bell and siphon discharge with the water and other con-

ditions indicated, immediately preceding priming. The pumps are capable of being primed with the suction water as much as 20 ft. below the pump runner and the discharge water at or very near the overflow or control point of the discharge siphon. The operation of priming, under these conditions, is accomplished by first starting the unit and bringing the motor to speed and then operating the vacuum pump until the water in the suction bell reaches the runner. The vacuum pump has suction connections both to the top of the siphon and to the bottom of the runner. As the air is withdrawn from the siphon the water in the downstream leg rises, ordinarily not more than 6 or 7 ft., and overflows into the pump and onto the runner. The revolutions of the runner throw the water to its periphery, where it passes through the blades and into the suction bell, probably as a hollow cylinder. The air connection at the bottom of the runner then withdraws the air from the center of this water cylinder and the water in the suction bell rises to meet the runner and the pump is primed.

This method of priming has proved entirely successful. It was determined upon after considerable discussion as to its feasibility, followed by tests on a model of the particular unit in the shops of the pump manufacturer. Whether the method would work satisfactorily with a centrifugal impeller is not known, but is doubted by the writers. The principal advantage is that it permits the use of a siphon discharge with the low point of the siphon throat just high enough to prevent back flow when the pump is shut down, rather than a siphon with low point as far above high discharge water as the runner sets above low suction water. Siphons meeting the latter and usual conditions would have been more difficult of construction and much more expensive, if not impracticable, considering the size and height that would have been required.

The siphon discharges which serve in lieu of valves were tested in a model (scale ratio = 12) in the hydraulic laboratory of the University of Michigan and later in the laboratory of the pump manufacturer. Certain modifications were made as a result of these tests which decreased the total head loss. Principally, it was found that the introduction of a vertical baffle in the downstream leg, dividing it into two equal channels, was advantageous and it was incorporated in the design.

The water delivered by the pumps is discharged from the 84-in. nozzle at an average velocity of 13 ft. per second and after traveling horizontally about 20 ft. is turned through 90 deg. to the vertical by a concrete elbow similar to a draft-tube under a water turbine. The vertical channel above the elbow is rectangular in section, expanding as it rises to dimensions at the top of 4.5 ft. by 16 ft. resulting in an average velocity of 7 ft. per second. The water then passes through the throat of the siphon and down the outside expanding vertical channel, where it is discharged at an average velocity of about 4.5 ft. per second, into a horizontal collecting channel.

It was an early expectation that an elbow and siphon could be designed that would make it possible to recover an appreciable portion of the velocity head of the pump. Based on the model test, however, this expectation was not realized.

The velocity head of discharge at the pump nozzles for rated discharge figure 2.62 ft. The loss of head through the elbow and siphon, based on model tests, amounts to about 2 ft., and the velocity head lost at the point of discharge into the common collecting channel to 0.31 ft. The total effect of the siphon design, so far as head is concerned, therefore, was to recover only about 0.31 ft., or about 12 per cent of the velocity head of discharge at the pump nozzle.

Had the pump been permitted to discharge freely into a discharge channel at the entrance to the elbow, through a diameter of 9 ft. 4 in., then, theoretically, about 1.97 ft. out of the 2.62 ft., or about 68 per cent, would have

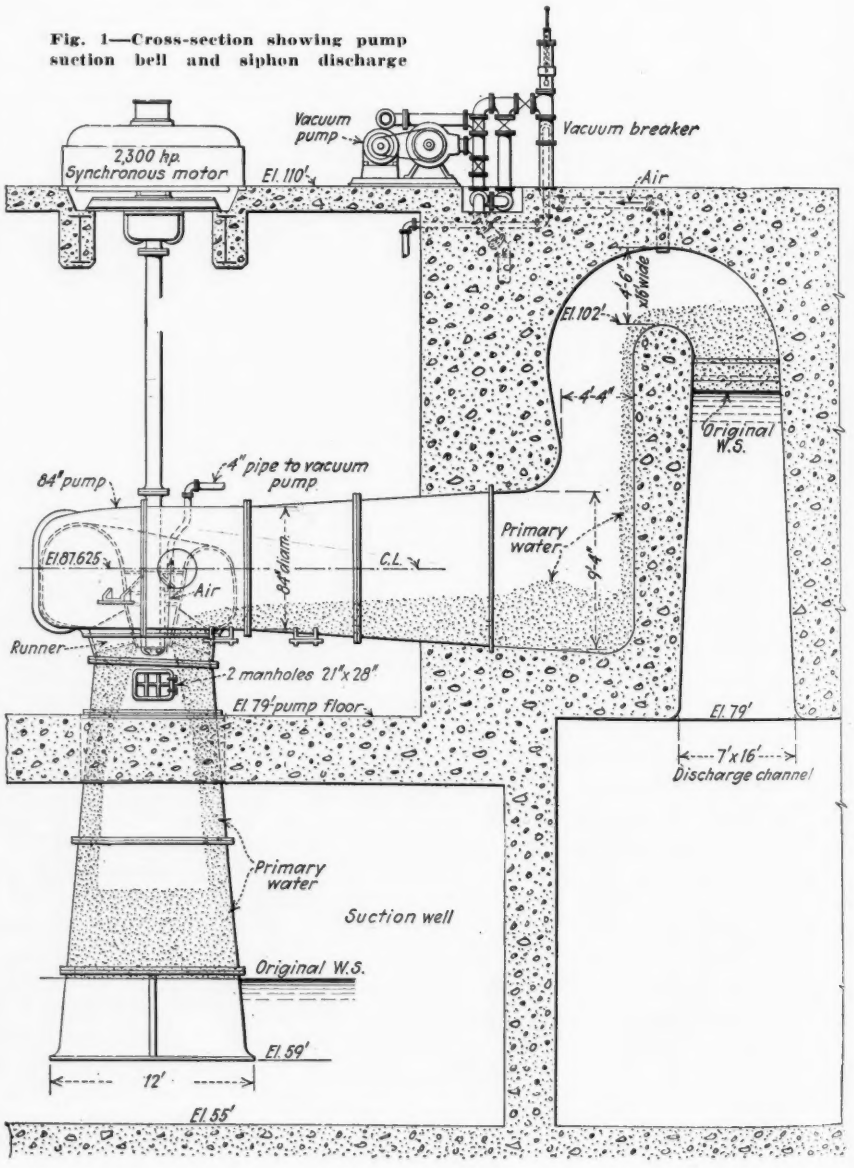



**Fig. 1—Cross-section showing pump suction bell and siphon discharge**

been recovered, neglecting the loss through 24 ft. of increaser. This latter arrangement would have required, however, the large control valve previously referred to. Allowing for the losses through the increaser beyond the pump nozzle and through the valve, it may be assumed that the adopted design requires the pump to operate against about one foot more head than if the design with valve had been used.

The type of setting, therefore, is not suggested as one generally applicable. Its use is probably limited to large units, intermittently operated. Where it is desired to avoid large valves and the added operating cost resulting from a somewhat increased head is, relatively, a small factor, the design is worthy of consideration.

### Unusual Specifications

It was an early assumption of the consultants, which subsequent experience fully justified, that the accurate measurement of dynamic heads on such large low-head pumps was difficult if not impracticable of accomplishment. The large diameters of suction and discharge nozzles, requiring to be traversed, and the marked irregularities in velocity and pressure distribution across different diameters, introduce problems difficult to meet in a field test. Hence it was decided to define "head" in the specifications as "Head of Elevation," meaning "the vertical distance between the elevation of the surface of the water in the suction well and the surface of water in the discharge channel well when the pump under consideration is in operation." This placed the responsibility of correctly estimating the "entrance and exit losses and the loss of head due to friction in the suction and discharge piping" on to the pump manufacturer. With a pump required to deliver a given capacity at a specified "head of elevation," the pump designer was required to furnish a pump in which the "total dynamic" head must be larger than the "Head of Elevation" by the estimated amount of the several losses specified. Although this was an unusual obligation to place on the bidder, it was common to all and obviously desirable under the conditions.

### Performance Required Over a Range of Heads

Instead of requiring performance guarantees for the rated head of 27 ft. only, a so-called "average guaranteed over-all efficiency" of the entire unit was called for, involving five different heads, ranging from 20 to 35 ft., each suitably weighted; and the "entire unit" was defined to include the pump and motor, suction and discharge piping and discharge conduit to the discharge channel well. It was also required that the pump deliver its rated capacity of 500 sec.-ft. at 27-ft. rated head.

### Comparing Bids

In comparing bids additions or deductions were made to the bid price on account of: *(a)* efficiency, *(b)* capacity and *(c)* size of sphere that would pass the pump. A value of $2,000 per unit per cent was placed on efficiency. As to capacity, it was desirable to have it increase as rapidly as possible with a decrease in head, or to obtain as flat a head-capacity characteristic as possible. The flatness of this curve was therefore evaluated by adding to the bidder's price: *(a)* $100 per sec.-ft. per unit that the guaranteed capacity fell below 600 sec.-ft. at 20-ft. head, and *(b)* $60 per sec.-ft. per unit that

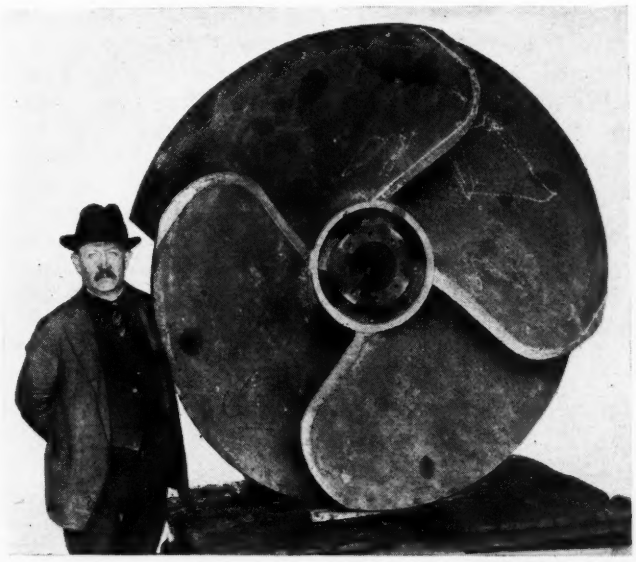


**Fig. 2—Runner of a pump similar to those used in the Connors-Creek pumping station**

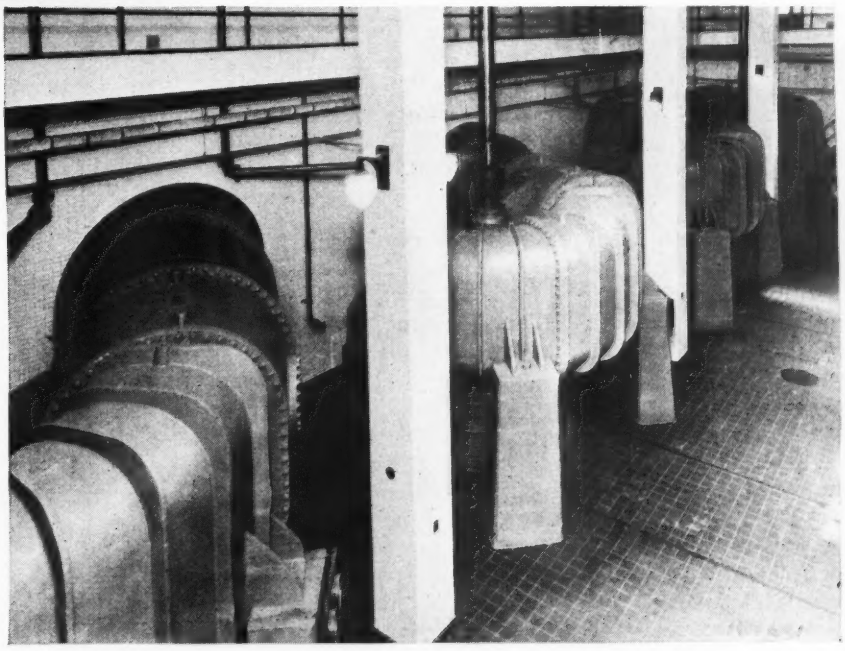


**Fig. 3—Each of the four pumps have a capacity of 225,000 g.p.m. against a head of 27 ft. The present capacity of the plant is 900,000 g.p.m. but is designed for double this amount by four more units at some future time**

guaranteed capacity exceeded 250 sec.-ft. at 35-ft. head.

These pumps are for storm water, the supply coming directly to them without passing through any racks. It was desirable therefore to secure the maximum practicable clear passageways for débris. After determining the minimum passageway satisfactory to several manufacturers, the specifications provided that, in comparing bids, a deduction would be made from the bidder's price at the rate of $500 per inch per unit above 10 in. up to a limit of 16 in. or $3,000 per unit.

### Failure to Meet Guarantees

Having compared bids on a basis that involved guarantees as to capacity and efficiency, it seemed logical and fair to all bidders to introduce into the contract

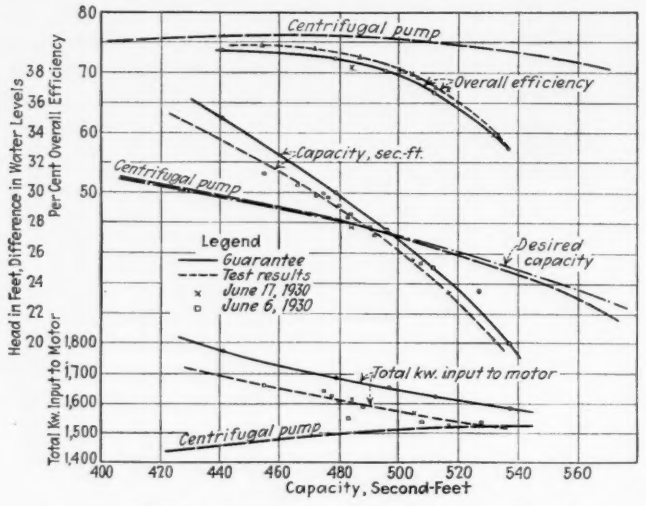



**Fig. 4—Power, head-capacity and efficiency curves for one of the pumps**

provisions for liquidating damages in the event the successful bidder failed to furnish a pump in accordance with the guarantees on which his bid was accepted. To accomplish this objective the following items were introduced into the agreement as measures of damage:

*(a)* One-half of 1 per cent of the contract price for each sec.-ft. below the guaranteed rated capacity that the tested unit failed to deliver.

*(b)* $100 per unit for each sec.-ft. that the tested unit failed to deliver its guaranteed capacity at 20-ft. head; and $60 per unit for each sec.-ft. that the tested unit exceeded its guaranteed capacity at 35-ft. head.

*(c)* $2,000 for each per cent per unit that the tested unit failed to meet the guaranteed average over-all efficiency.

### Efficiency Tests

Field tests for capacity and efficiency were carried out on one unit following more or less standard methods. The head was determined by float gages in the suction and discharge channels. The discharge was measured over a sharp-edged weir in the main discharge channel outside the pumping station and some 140 ft. beyond the point of discharge from the building wall. The weir had a crest length of 29.79 ft. and a height of 17.71 ft. above the channel bottom. Electrical measurements were taken by calibrated instruments.

The efficiency, head-capacity and power curves as guaranteed and shown by test are presented in Fig. 4. The efficiency guarantees appear to have been slightly exceeded, about 1 per cent at the rated head. In capacity there was an apparent deficiency of about 1 per cent, subject, however, to some correction for weir losses or other inaccuracies in water measurement. The power required by the motor is less than that called for in the guarantee. The conclusions of the engineers were that the performance guarantees had been substantially met, and the unit was accepted.

In Fig. 4 are also shown the head-capacity curve aimed at by the specifications and a head-capacity curve covering a centrifugal pump; the corresponding power and efficiency curves are also shown for this type of pump. It may be noted that the head-capacity curve of the runner purchased is steeper than the one desired by the consultants, while that of the centrifugal impeller corresponds closely with the desired curve.

### Starting Requirements

Although the specifications contemplated that the pumps would ordinarily be started with the casings empty and with a suction head requiring priming, it was also provided "that the equipment must be capable of starting . . . . when the suction water is well up in the pump casings." Further, in order to anticipate storm conditions, the pumps were required to be capable of running "with the casings empty for an indefinite period of time." This latter condition required "all wearing rings, if any, stuffing boxes and steady bearings" to be "adequately cooled and lubricated."

With the four units there were required four vacuum pumps all interconnected so that any vacuum pump could be used with any unit. Each vacuum pump was required to have "at least sufficient capacity to be capable of exhausting the air from any pump casing and piping at such a rate as to enable the pump to deliver water within five minutes after starting the vacuum pumping equipment." It was also provided that the vacuum equipment shall be so installed as to be capable of forcing the suction water down below the bottom of the runners, in the event the runners were submerged at the time of starting, and the time of starting under these conditions was also not to exceed five minutes.

### Omission of Racks

The fact that no racks intervene between the incoming storm water and the pumps may well be emphasized. This feature constitutes a departure from

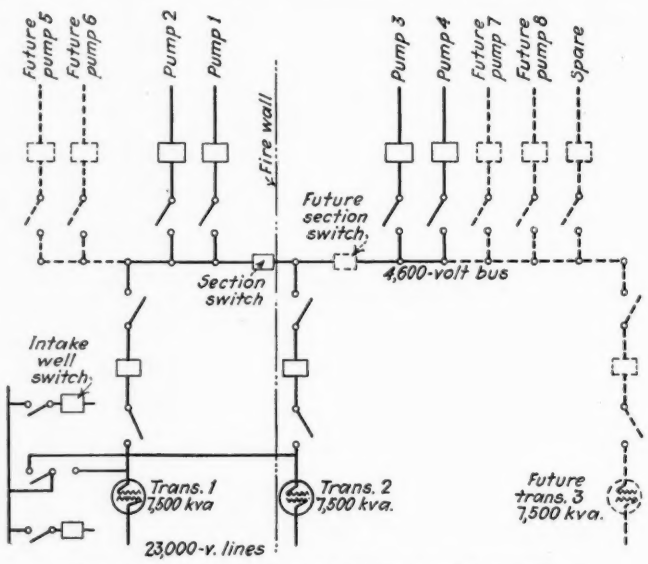



**Fig. 5—One-line diagram of busbar and transformer connections**

precedent in pumping stations. It was adopted because of the difficulties involved, under the conditions, in rack construction and operation and of the uncertain benefit to be gained where it was desired to pump, as far as possible, all trash and solid matter. The purpose of a rack, under such conditions, would be only to protect the pumps from heavy water-logged timbers or ties that might and occasionally do find their way into large city sewers. Presumably, much of the floating timber and débris will not be drawn into the suction bells and will be removed from the suction pit following a storm, as provisions for readily draining, entering and cleaning the suction pit were incorporated in the station design. No doubt the design and strength of the pump is such as to handle without difficulty all ordinary débris, as the substantially constructed runners are of cast steel and will pass a sphere 16 in. in diameter. The chance of damage to a pump from a large timber is a possibility, but probably a remote one. Under these conditions the consultants advised the omission of racks.

This station is primarily for storm-water pumping and, while for the most part used intermittently and for relatively short periods of time, great damage might result if it failed to operate promptly in time of storm. It is therefore essential that electric power be available at all times.

## Electric Power Supply

Power at 24,000 volts is supplied by the Detroit Edison Company from two different substations through two underground cables. Each cable is connected to a 7,500-kva., 3-phase transformer through pot-heads. These transformers step down the voltage to 4,600, which is taken into the primary switch house through underground cables. A 4,000-gal. oil storage tank is installed near the transformers so that the oil can be pumped out of either transformer in case of emergency or for inspection. An oil pump is provided for this purpose, and also connections for drying the oil.

The 4,600-volt bus structure is of the open type and supported on pipe framework. There are installed at the present time three 1,200-amp., 7,500-volt and six 400-amp., 7,500-volt oil circuit breakers, with provision for seven more to take care of the future load. These breakers have an interrupting capacity of 20,200 amp. at 4,500 volts and are direct-current solenoid-operated. The bus is sectionalized by a section switch, and a transformer feeds each bus as in the diagram, Fig. 5. A fire wall was built between the section switch and the switch on transformer No. 2, so that in case fire started in either room it would only put out of commission one half of the pumping equipment in the main station.

When the other pumps and the third transformer are installed another section switch will be placed in the bus so that transformer No. 2 can feed either bus. On account of the 24,000-volt feeds coming from two different substations, it was necessary to interlock the section switch with the two transformer switches, so that the three could not be closed at the same time and thus tie the two substations together. In order that the house-service transformers and the intake well can be fed from either power transformer, connections were made between the 4,600-volt feeds from the power transformers and double-throw disconnecting switches with the blade connected to the auxiliary 4,600-volt bus. All the oil circuit breakers are controlled from the switchboard, Fig. 6, which is installed in the main station.

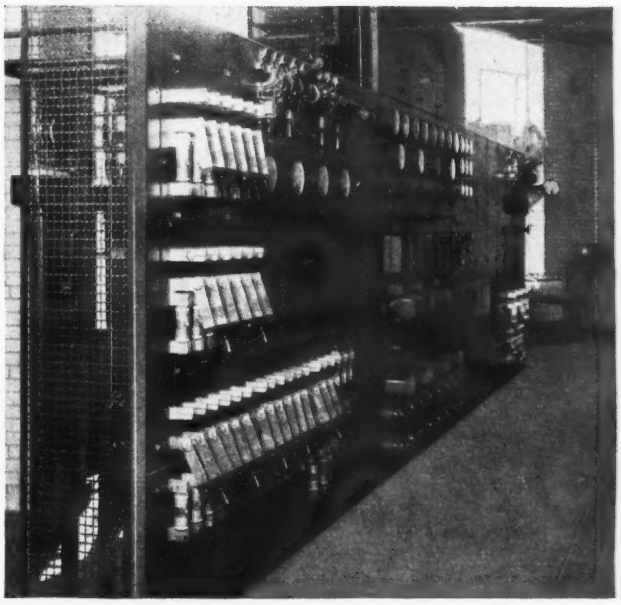


**Fig. 6—Main switchboard from which all the oil circuit breakers are controlled**

On the pumps the motors are of the synchronous type, rated 2,300 hp. at 4,600 volts and are to operate at unity power factor. They are designed for full-voltage starting; that is, when the 4,600-volt oil circuit breaker is closed, full voltage is applied to the motor and after a definite time the field contactor is closed and the motor pulls into step. This type of starting not only reduced the cost of starting equipment, but also the size and cost of the primary switchhouse. The specifications limited the starting current to not more than 4.75 times the rated full-load current, and at no time can the in-rush exceed 10,000 kva. per motor.

The motors were designed with sufficient starting and pull-in torque to start the pumps and pull into step with the pump casings full of water. Under normal operation the pumps are started with the casings empty. The motors are protected from overheating by thermal overload relays and by differential relays in case the stator coils or cables between the motor and oil circuit breakers break down.

Separate excitation is provided for the motors from motor-generator sets. There are installed at present three 35-kw. sets, and provision is made for two more. These are of sufficient capacity so that one can be out of commission for repairs and the remaining two will take care of the fields of all the motors. These motor-generator sets are controlled from the switchboard.

This equipment was furnished and installed by the Worthington Pump & Machinery Corporation of Harrison, N. J., at a total cost to the city of Detroit of $153,734. The motors, motor-generator sets, oil circuit breakers and switchboard with instruments and relays were furnished by the Westinghouse Electric & Manufacturing Company. Purchases were made under the direction of Perry A. Fellows, then city engineer of Detroit. Plans for the pumping-station superstructure were prepared by the staff of the city engineer, under the direction of Milton F. Wagnitz, engineer of public structures, and those for the substructure by Ayres, Lewis, Norris & May, engineers, Ann Arbor, Mich. Harrison P. Eddy, of Boston, Mass., Gardner S. Williams and the writers acted as consultants.

# Types of Steam Turbines and Their Application

**The selection of the proper type of turbine is not difficult when the conditions of operation and the various types of turbines available are known. This article is a brief non-technical description of conditions under which the different types should be applied**

By G. R. PROBST

ERRORS in the selection of the proper type of turbine will result in the loss of substantial savings. Such errors may readily be avoided when conditions of operation are known so that the proper type of turbine may be chosen. Then by building the turbine to fit, it will prove to be the most economical by producing power at the minimum cost.

Simple non-condensing steam turbines are used when all or practically all of the exhaust steam can be employed for process and heating, or when the cost of fuel or steam is such that the additional investment required for condensing equipment, or a more intricate turbine is not justified. This type of turbine is usually employed in the smaller sizes where the additional cost of a more elaborate design of turbine would exceed the saving resulting from the possible lower steam consumption. Non-condensing turbines may be built either in the single-stage or the multi-stage type. When low steam consumption is desired the multi-stage is usually used, as this type is more efficient for average conditions. This is especially true in units of 100-kw. and above. The field for a highly efficient turbine in the smaller sizes does not ordinarily justify the development of a turbine of the multi-stage type.

With increasing high steam pressures and temperatures straight non-condensing turbines exhausting against high back pressures are rapidly coming into use. These turbines may be employed to exhaust steam at practically any desired pressure, providing that the boiler pressure is sufficiently high so that a reasonable drop is available between boiler and exhaust pressure. One particular application of turbines of this type is their use when it is desired to increase the generating capacity of a plant and at the same time maintain the existing steam equipment which operates at a relatively low or medium steam pressure, say between 100 and 200 lb. For such conditions high-pressure boilers are installed which feed non-condensing steam turbines exhausting into the main header of the existing moderate-pressure boilers. In this manner the highly efficient high-pressure boilers usually carry practically all of the load, while the existing moderate-pressure boilers are floated on the line and make up any deficiency in the steam required to operate existing equipment over the amount that is available from the exhaust of the high back-pressure turbine.

Non-condensing turbines actually operate as reducing valves, and as they utilize only approximately 6 to 10 per cent of the total heat in the steam, power is produced practically as a byproduct and at a minimum cost.

When it is desired to generate energy with the minimum amount of steam under such conditions as exist in central power stations or industrial plants using no steam for process work, straight condensing turbines of the multi-stage are used. Industries requiring considerable quantities of hot water for process often employ straight condensing turbines operating at a reduced vacuum. The condenser acts as a heater for the circulating water and at the same time the turbine is given the advantage of the additional heat available for power through exhausting into a vacuum. The vacuum into which the turbine exhausts is determined by the temperature at which the water is desired for process or heating. Automatic control of the water circulated through the condenser to maintain a constant temperature with varying electrical loads is available. This method of operation not only produces power and hot water with the minimum amount of steam, but shows a high over-all economy, as practically all of the heat in the steam is utilized.

The cost of a straight condensing turbine installation is higher than that of the non-condensing type, as the number of stages in the turbine required for efficient operation is greater, and the cost of condensing equipment must also be included.

### Low-Pressure Turbines

Straight low-pressure turbines are installed when a surplus of exhaust steam or low-pressure steam is available and it is desired either to increase the electrical generating capacity with the existing boiler plant or to reduce the coal consumption and maintain the same power load. These turbines are of the straight condensing type, and as surplus exhaust steam is used which cannot be utilized in process work, power produced in this manner is generated at a low cost.

For instance, in plants that are able to utilize all of the exhaust steam from non-condensing equipment in

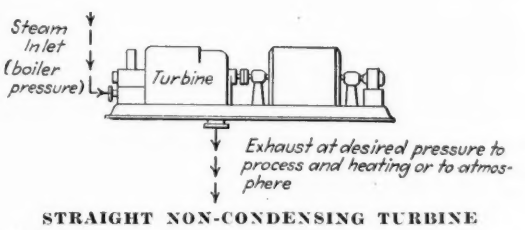
winter for heating, but are required to waste the steam in summer, such a turbine may be economically applied. Under these conditions the low-pressure turbine is operated during the periods when no steam is required for heating or when the heating load is light. As the power produced by a low-pressure turbine taking steam at one pound gage and exhausting into a 28-in. vacuum is practically the same as that which can be produced from non-condensing equipment when supplied with steam at 150-lb. and exhausting to atmosphere, it is apparent that if the electrical load remains the same the coal requirements will be reduced practically 50 per cent.

### Mixed-Pressure Turbines

Conditions often exist during certain periods when there is an excess of low-pressure or exhaust steam that cannot be utilized in process work. When this supply of low-pressure steam is variable and of an insufficient quantity, a straight low-pressure turbine cannot be used to generate all of the power required. For such conditions a mixed-pressure turbine will generate power at a minimum cost. This type consists, essentially, of a high-pressure element and a low-pressure element with the governor so arranged that all of the available low-pressure steam will be used for power generation before high-pressure steam is admitted to the turbine to carry the required load. Various industries, such as oil refineries, having a large number of steam-driven pumps and similar apparatus in operation find that at certain times all of the exhaust from this equipment cannot be utilized in process work. The installation of a mixed-pressure turbine either will supply any additional power required or will reduce the fuel consumption of the plant by producing power from the exhaust steam. As the turbine is capable of operation as a straight condensing machine, it will produce power efficiently when no exhaust steam is available.

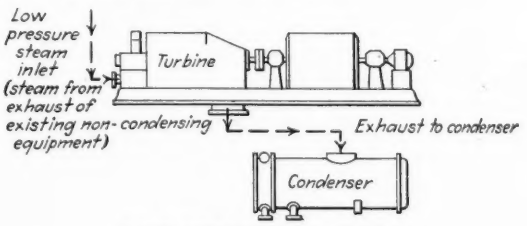
Although this type of turbine is somewhat more complicated in design and construction than either the straight non-condensing or the condensing types, operation is wholly automatic and requires practically no more attention or maintenance.

In determining whether a mixed-pressure turbine should be used, the amount of low-pressure or exhaust steam available should be known, to proportion the turbine properly to best suit the conditions. If the amount



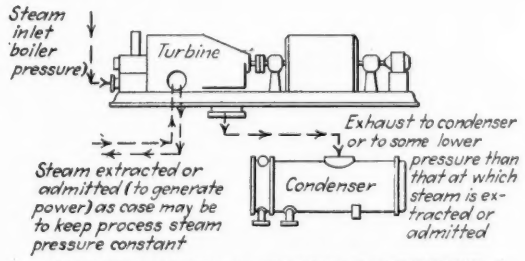

**STRAIGHT NON-CONDENSING TURBINE**

*Used:*
1. When all or practically all of the exhaust steam can be used for process or heating
2. When very low priced fuel or steam is available
3. When no condensing water is available
4. For small units


Low pressure steam inlet (steam from exhaust of existing non-condensing equipment)
Turbine
Exhaust to condenser
Condenser

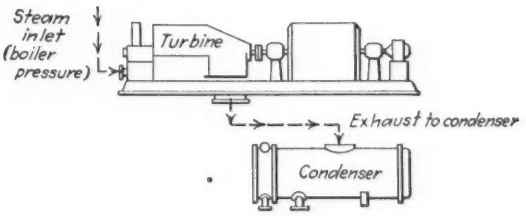
**LOW-PRESSURE TURBINE**

*Used:*
1. When a constant or nearly constant supply of exhaust steam is available
2. With non-condensing apparatus in periods when exhaust cannot be used for process or heating
3. To increase power output of plant without increasing boiler capacity


Steam inlet boiler pressure)
Turbine
Exhaust to condenser or to some lower pressure than that at which steam is extracted or admitted
Steam extracted or admitted (to generate power) as case may be to keep process steam pressure constant
Condenser

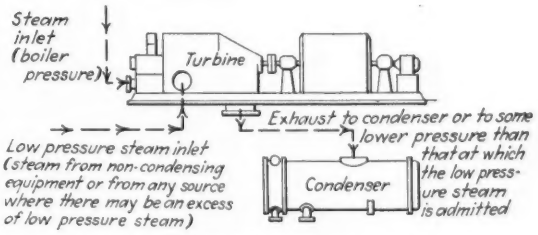
**MIXED-PRESSURE BLEEDER TURBINE**

*Used:*
1. When at a certain period there is an excess of low-pressure steam, and at other times a deficiency
2. To supply process steam when necessary and to utilize surplus of the exhaust steam when available



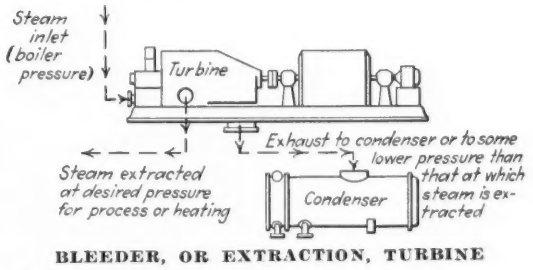

**CONDENSING TURBINE**

*Used:*
1. When no steam is required for process or heating
2. To produce power with a minimum amount of steam
3. To heat condenser circulating water for process work


Steam inlet (boiler pressure)
Turbine
Exhaust to condenser or to some lower pressure than that at which the low pressure steam is admitted
Low pressure steam inlet (steam from non-condensing equipment or from any source where there may be an excess of low pressure steam)
Condenser

**MIXED-PRESSURE TURBINE**

*Used:*
1. When there is a varied or intermittent supply of exhaust steam available
2. When power to be generated is greater than that which can be generated from available exhaust steam


Steam inlet (boiler pressure)
Turbine
Exhaust to condenser or to some lower pressure than that at which steam is extracted
Steam extracted at desired pressure for process or heating
Condenser

**BLEEDER, OR EXTRACTION, TURBINE**

*Used:*
1. When process steam requirements are intermittent
2. When process steam requirements are variable
3. When process steam requirements are such that all power cannot be generated from a straight non-condensing turbine
4. When process steam is required at one or more pressures

of exhaust steam available is large more consideration is usually given to a highly efficient low-pressure element, whereas if the quantity is small more consideration is given to the efficiency of the high- pressure element.

### Bleeder or Extraction Turbines

In process industries bleeder, or extraction turbines, as they are sometimes called, are used to a far greater extent than any other type. They may be either of the condensing bleeder type or the non-condensing bleeder type depending entirely upon conditions under which they must operate. The economy of the bleeder type turbine lies in the fact that power is generated from the steam before it is bled from the turbine for process or heating, and any additional power required over that which is available from the bled steam is efficiently generated by the turbine acting either as a straight condensing or a non-condensing type. Bleeder turbines are used when the process steam requirements are variable or of an insufficient quantity so that a non-condensing turbine cannot be used without wasting a certain amount of exhaust steam to atmosphere. Under this condition straight condensing turbines are not as economical to operate, as they do not take advantage of the power available from the steam required for process. Bleeder turbines therefore, offer one of the most economical means of securing power and process steam.

Both the automatic type of bleeder which holds the pressure constant in the process or heating line and the non-automatic type which may not hold this pressure constant for all loads are available. When the process steam demand and load, or both, are variable, the automatic type should be employed. When the load is practically constant and relatively near full capacity of the unit, and if a constant amount of steam is required for process work, a non-automatic bleeder, which consists of an opening at a predetermined stage in the turbine, may be used. However, the economy of this type for usual conditions will not be as high as that of the automatic type. In the non-automatic turbine the pressure in the bleeder stage will vary with the load, and as a reducing valve or constant-pressure valve is installed in the bleeder line to hold this pressure constant there is throttling through this valve which results in a loss of power. This throttling action does not occur in the automatic bleeder. Just when the automatic type or the non-automatic type should be used can be determined only from the conditions under which the turbine must operate.

In many plants conditions are such that steam is used at one or more pressures for process and heating. The bleeder turbine may be designed and constructed so that it will bleed steam at one or more pressures in varying amounts.

Plant conditions are often such that when process steam is required at one or more pressures it will be found that sufficient power can be produced by bleeding steam at the higher process pressure and exhausting at the lower pressure. As the pressure of the bled steam is automatically held constant regardless of variation in demand, the amount of steam available at exhaust pressure for process work will depend upon the power load. If the power load is light and requirements for bled steam are high, it may be found that there will be a deficiency of exhaust steam, in which case this deficiency will have to be made up by means of a reducing valve from either the high-pressure line or the bled steam line. When the load is heavy and only a small quantity of steam is required at the bleeder pressure there may be some excess of exhaust steam which will have to be wasted to atmosphere if it cannot be used in process or heating. Although this waste may occur at certain intervals, a careful check of costs will often show that it is not sufficiently large to justify the extra expenditure required for a condensing type of bleeder turbine and condensing equipment.

When the electrical load exceeds the power that can be generated from a non-condensing bleeder type of turbine, a satisfactory arrangement is a non-condensing bleeder turbine generator unit synchronized with an outside source of power and so controlled that only the proper amount of steam will be admitted to fulfill the needs for process steam at the required pressures. This control consists, essentially, of a device which holds the pressure at the exhaust of the turbine constant and will admit the proper amount of steam to supply the amounts required at both the bleeder pressure and the exhaust pressure. In a unit of this type the power which it produces will be in proportion to the steam used for process work at the various pressures.

To secure maximum economy from a bleeder turbine, whether it be of the condensing bleeder type or the non-condensing bleeder type, maximum, minimum and average requirements of both power load and process steam load must be known. With this information the turbine designer is in a position to so proportion the various elements of the turbine as to assure maximum economy for the entire operating range.

### Mixed Pressure Bleeder Turbines

Conditions often exist where there is an excess of exhaust steam during certain periods while at other times there is a deficiency. Such conditions may be found in a plant where the summer requirements for process steam are small and an excess is available from non-condensing engines, turbines or other steam-driven equipment. In the winter there may be a large heating and process steam load that requires a greater amount of steam than can be secured from the existing non-condensing equipment. To balance conditions such as these a mixed-pressure bleeder turbine may be installed. When there is a deficiency of low-pressure steam for process or heating the turbine operates as a bleeder machine and maintains the desired pressure in the low-pressure heating and process steam line. When the reverse condition obtains and there is an excess of low-pressure steam, the turbine acts as a straight mixed pressure or a low-pressure turbine, taking in the excess of low-pressure steam and generating power from it.

With such a turbine it is possible to maintain an efficient heat balance under all conditions of load and process steam requirements, as no steam at any time will be wasted to atmosphere. As the control mechanism of the mixed-pressure bleeder turbine is entirely automatic, the operation, care and maintenance of such a turbine is relatively simple.

It is evident from the description of various types of turbines that in order to generate power and secure process steam at minimum cost, or utilize low-pressure steam, the actual conditions under which the turbine will operate must be clearly understood. The electrical load that the unit must carry at all times should be carefully studied, and for the corresponding electrical load the amount of process steam required, or the amount of ex-

haust steam available for generation of power, should be accurately determined. These steam quantities should be always given in average, maximum and minimum amounts, together with the corresponding average, maximum and minimum electrical load, as these are the determining factors in the design of the turbine. After this information has been carefully determined the turbine designer can then select the proper number of stages, location of bleeder outlet or steam inlet points and design nozzling for the turbine so that maximum over-all efficiency will be secured. In some instances it may be necessary to sacrifice efficiency at one particular point in order to secure a greater over-all efficiency under all conditions of operation.

Although the more common types of commercial machines have been discussed, there are also available a number of variations of the foregoing types which can be fitted to unusual and complex conditions. For unusual conditions the essential departure from the conventional types will be found in the method of controlling either the bled steam, the exhaust steam or the amount of steam taken into the turbine. In addition to pressure control, heat control through means of a thermostat is available and can be applied to the various turbines with little difficulty. The flexibility of the turbine design and the relative ease with which various types of turbines are constructed, make them especially suited for generation of power at a minimum cost. Savings which may be effected by the installation of a turbine unit are often such that the installation will pay for itself in one or two years, but in order to obtain the best results at a maximum saving all conditions under which the turbine will operate should be clearly outlined to the turbine builder.

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# Water-Tube Boiler Used as a Desuperheater

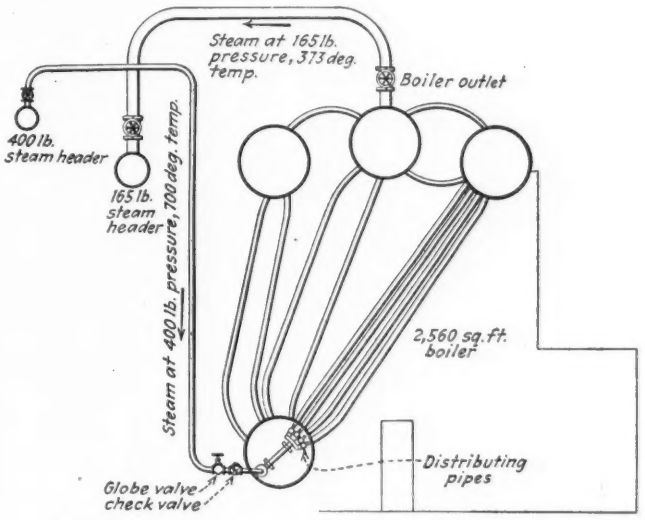
THE UNUSUAL and practical method of securing low-pressure superheated steam by injecting high-pressure, highly superheated steam into a low-pressure boiler has been developed at the National Cash Register Company's plant at Dayton, Ohio. This low-pressure steam is being obtained without interfering in any way with the normal function of the low-pressure boiler in producing steam from fuel burned in its furnace.

The low-pressure boiler thus used is an old type of bent-tube unit. Steam is injected into the boiler through the mud drum and distributed through a group of nozzles in such a manner that the steam is directed into the bottom of each tube of the front bank of tubes. Water circulation is thus set up in the same direction as is maintained in the normal operation of the boiler when heated by fuel.

The distributing headers and nozzles are far enough away from the tube inlets to permit the free entry of water without hindering circulation. The operation of the boiler may be changed from operation by fuel to operation by high-pressure steam, or vice-versa, without loss of capacity or pressure. The water level is maintained at normal height in the boiler when operated by superheated steam. The boiler has been operated at 200 per cent of rated capacity for lengthy periods in this manner without signs of priming or foaming.

When operated by superheated steam, feed water is fed into the boiler in the regular manner. The only difference is that less than 20 per cent as much water is required as would normally be needed at the rating developed. The boiler operates in this manner without noise or vibration. There is no hammering or cracking, such as is usually developed when condensing steam in water, due to the fact that there is no condensing and collapsing of steam bubbles. Additional steam is generated instead of condensation occurring. The output of the boiler is governed by the amount of steam injected into it. This is manually controlled by a conveniently located throttle valve.

Steam for injection into the boiler comes from the high-pressure system at a pressure of 400 lb. and at the temperature of 700 deg. The steam produced is at 165 lb. pressure without superheat.


Steam at 165 lb. pressure, 373 deg. temp.
Boiler outlet
400 lb. steam header
165 lb. steam header
Steam at 400 lb. pressure, 700 deg. temp.
2,560 sq. ft. boiler
Distributing pipes
Globe valve
check valve

**High pressure steam is injected into the lower end of the front bank of tubes**

The use of the method was evolved by engineers of the company in their search for a way of securing low-pressure saturated steam from their high-pressure system without risking the damage which could occur, and which would be particularly costly at the plant, if high-temperature steam were permitted to enter the low-pressure system for even a short time.

Observations made in the operation of the boiler now in use indicate that a loss of feed water to the desuperheating boiler may be sustained for a period of an hour or more without danger of producing steam at an excessive temperature. This method of desuperheating was developed by E. D. Smith, plant engineer, and B. E. Tate, chief engineer of power plant.

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EXPERIMENTS of Prof. P. W. Bridgeman of Harvard University have disclosed that at extremely high pressure the melting point of ordinary ice falls to lower and lower temperatures as the pressure increases until at 30,000 lb. pressure it melts at about four degrees below zero. As the pressure is increased beyond this point ordinary ice is no longer stable, and four other different forms occur, which are stable up to successively higher and higher temperatures as the pressure increases. At 300,000 lb. pressure water is solid up to 180 deg. F. Ice at this temperature can burn one severely.

# Valve Adjustment On Gas Engines

By U. A. PATCHETT
*Engineering Department*
*Stanford University*

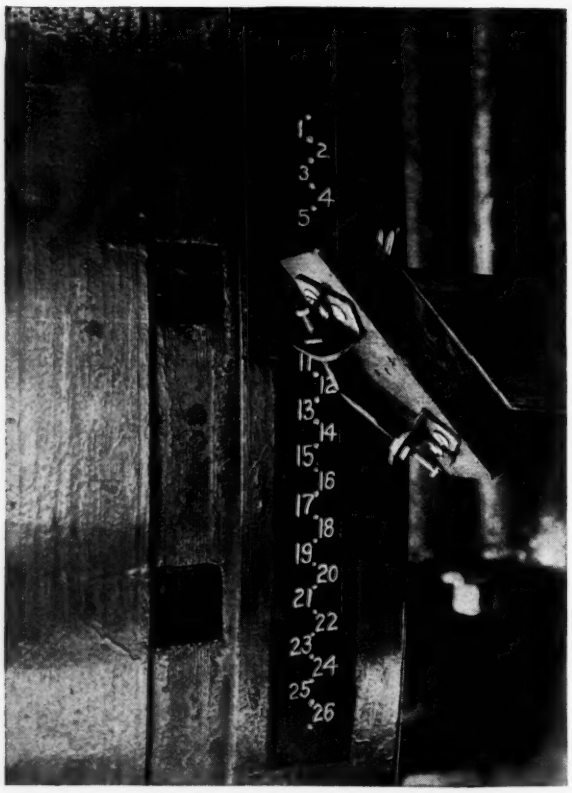


**Fig. 1—Determining spark lag by flash of spark gap**

To obtain best operation from any gas engine it is not only necessary to have the correct fuel air ratio, but this mixture must be taken into the cylinder, ignited, and the products of combustion exhausted at the proper time. The timing of these events is not the same for all engines. It varies with the cylinder size, shape of clearance space, compression ratio and engine speed, and should be determined by test on any particular engine

TO OBTAIN satisfactory results from a gas engine the method of adjusting the engine must be such that exact timing of the valves and ignition is obtained. The following deals with a method devised while making such a test.

The engine used was an 18 by 20-in. four-stroke-cycle, two-cylinder, horizontal unit, rated 180 hp. at 200 r.p.m. The camshaft was driven through a set of bevel gears from a layshaft, which in turn was driven by a drag crank from the main crankpin. The drag crank was connected to the layshaft by a flanged coupling with slotted holes. Small adjustments of the camshaft could be made by loosening the flange bolts and advancing one-half of the coupling; large adjustments, by slipping a tooth on the gears. A scraper, for lubricating purposes, on the camshaft large bevel gear made a good stationary reference for marking the camshaft position.

Two methods were used for setting the valves. The first was as given in the instruction book for this engine. It consisted of first adjusting the clearance between the valve cam and follower to 0.020 in. while the follower was on the cam base circle. Next a bent iron strap, with set-screw, Fig. 2, was placed over the inlet valve of the cylinder to be tested, and fastened down with the inlet-valve cover bolts. The engine then was turned over until the inlet valve was nearly ready to open. A thin feeler was placed on top of the valve guide nut and barely clamped by turning down the set-screw, the screw being locked with the locknut. The engine was turned over slowly until the feeler was just loose. The inlet valve was then starting to open. If the markings on the flywheel did not correspond to the desired setting of the valve, an adjustment had to be made. This adjustment was performed by setting the flywheel at the desired position for the opening of the inlet valve, the feeler was set as before, and the camshaft shifted until the inlet valve started to open.

In the second method the valve pushrod clearance was set as in the first method. The cylinder to be adjusted was placed at top dead center on the suction stroke, and the camshaft position marked on the large bevel gear. The engine then was turned backward far enough to insure complete closure of the inlet valve. An Ames dial gage, reading to a thousandth of an inch, was then placed against the valve stem, using a special clamp to hold it in place. The valve opening was recorded for every five degrees of crankshaft rotation, from the closed to the full open position of the inlet valve.

The exact setting of the valve was found from a reference point, which was determined by plotting the valve lift against flywheel position. This reference

point was the intersection of the zero, lift line with the extension of the straight central portion of the valve-lift curve point *X*, Fig. 3. Tests indicate that for this particular engine the reference point should occur about 10 deg. after top dead center. If the valve lift curve did not show the desired valve timing, the valve was reset. As an example, suppose the inlet valve was found to open 10 deg. late. That cylinder would have been set 10 deg. before top dead center on the exhaust stroke, and the camshaft shifted back to its original position when the flywheel was on top dead center position, as indicated by the mark on the large bevel gear.

The accuracy of setting the cam by the feeler method depends on the shape of the lift curve at the point of valve opening. If the curve rises sharply the method gives good results; but if the curve is flat, such as is used to quiet valve noises, this method may give erratic results. This is due to the fact that with the valve-quieting cam the valve opens very slowly at first. Thus any variation in adjusting the valve clearance before setting the valve, inaccuracies in grinding or wear in the cam itself, may cause the apparent point of valve opening to vary 10 to 15 deg. With the fast opening cam any of these inaccuracies are taken up by the steepness of the curve in 2 or 3 deg. of flywheel travel.

The valve-lift curves for the two types of cams are shown in Fig. 3. These curves were obtained with an Ames dial gage, the valve pushrods being adjusted with no clearance, after the valves in the two cylinders had been carefully set by the feeler method. When the engine was equipped with the fast-opening cams nearly identical valve timing was obtained for the two cylinders, as shown by the valve-lift curves; but when equipped with the valve-quieting cams one valve led the other by 15 deg. of crankshaft rotation.

Ignition on this engine was obtained by an oscillating-trip type of magneto. In this system a definite time is required before the spark occurs in the cylinder after the magneto trips. This time lag varies with the magneto used, and depends on the strength of the spring; that is, the weaker the spring the greater is the lag. The two magnetos on this engine were tested at a speed of 196 r.p.m.; one was found to have a lag of 17 deg., and the other 23 deg. This shows that with this type of magneto the ignition timing cannot be adjusted by merely setting the time of the trip without taking the lag into consideration.

To determine this ignition lag a spark gap was connected to the high-tension wires in series with the spark-plug, the gap being clamped to just clear the face of the flywheel. A piece of white paper about 2 ft. long, marked off in 1-in. divisions, was pasted to the flywheel rim, Fig. 1, so its leading edge was exactly opposite the spark gap at the time the magneto tripped. At night, with all lights out, the spark gap illuminated the paper strip sufficiently to obtain a time photograph of the portion just opposite the gap. Since the spark was instantaneous, compared to the flywheel speed, and occurred at the same point on the flywheel each time, the divisions of the paper strip appeared on the photographic film as though they had been stationary. Since the leading edge of the paper strip was opposite the gap at the time of magneto trip, the division opposite the gap, as shown by the photograph, was the lag in inches of flywheel travel at that particular speed.

This method is simple but requires a great deal of time to obtain the results. There are a number of dif-

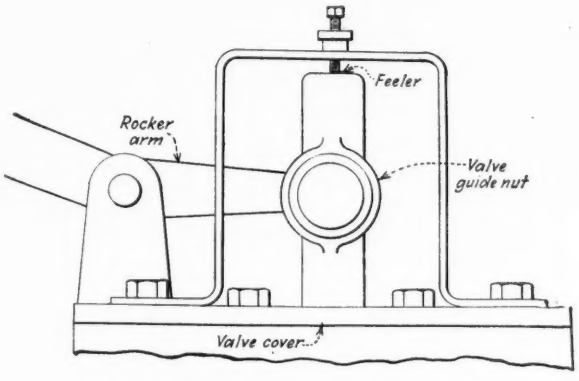


Fig. 2—Checking valve timing by feelers

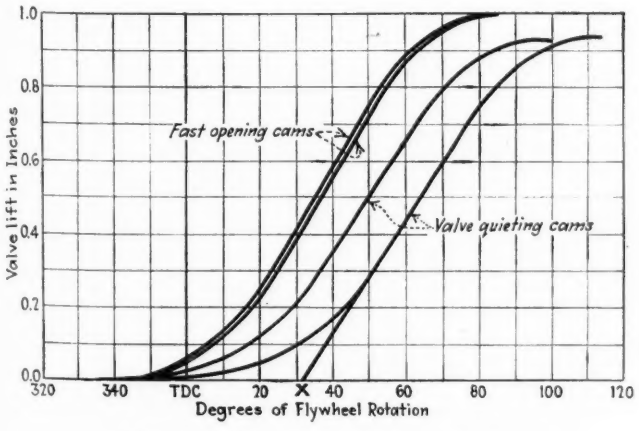


Fig. 3—Action of two designs of cams

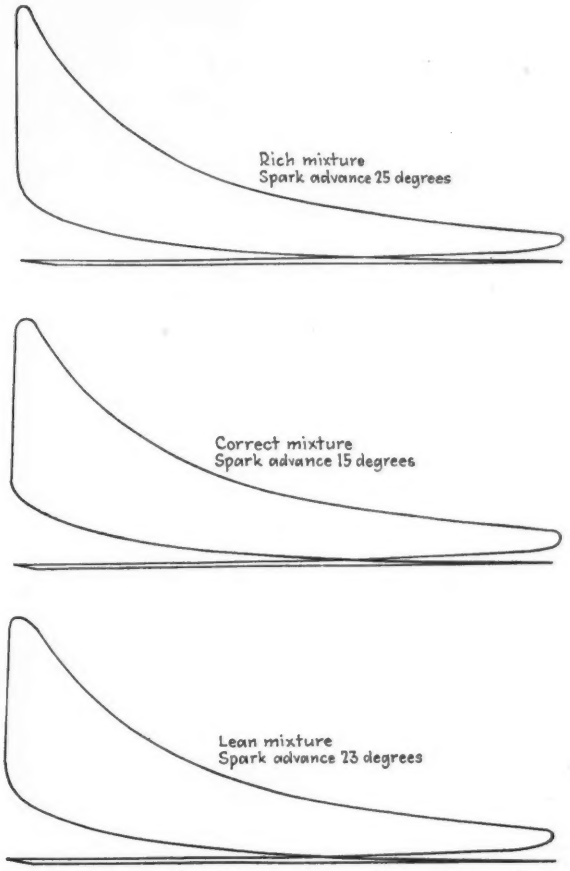


Fig. 4—Excellent indicator diagrams with various mixtures

ferent methods that might be used. For a large plant some quicker method would be better, such as a small flywheel, with a cam for tripping the magneto, that could be rotated at a higher speed. With this apparatus the spark would occur frequently enough that, due to the persistence of vision, the divisions on the paper strip could be seen with the naked eye. From this reading, and the speed of the flywheel, the actual time lag could be calculated and converted to degrees of flywheel rotation for any other engine speed.

One might ask, "Why take all this trouble to determine the lag when the spark could be set by the use of a cylinder indicator?" The indicator method gives good results provided the fuel-air mixing valve is set for the proper mixture. Tests were made to determine the effect of the fuel-air ratio on the spark timing. It was found that nearly perfect indicator diagrams, Fig. 4, could be obtained, by adjusting the spark, for any mixture ratio that would give consistent firing in the cylinder. The reason for this is: for each particular gas there is one fuel-air mixture having the greatest rate of flame propagation, and either leaning or enriching the mixture, within the limits of combustion, slows down this rate of burning. The effect of this slower-burning mixture in the cylinder is counteracted by advancing the time of ignition. Thus for any engine tests should be made to determine the best setting of the mixing valve and the corresponding ignition timing. It will be easy, then, to set the engine at any later time by adjusting the spark advance to that determined in this test and varying the mixing valve so as to give the best indicator diagram.

It was found in these tests that a variation of 5 deg. in either the spark or valve timing decreased the indicated thermal efficiency by 1 or 2 per cent. Thus the method used for timing an engine should be accurate, at least to within 2 or 3 deg. of crankshaft rotation. The gas-to-air ratio can then be adjusted for best results.

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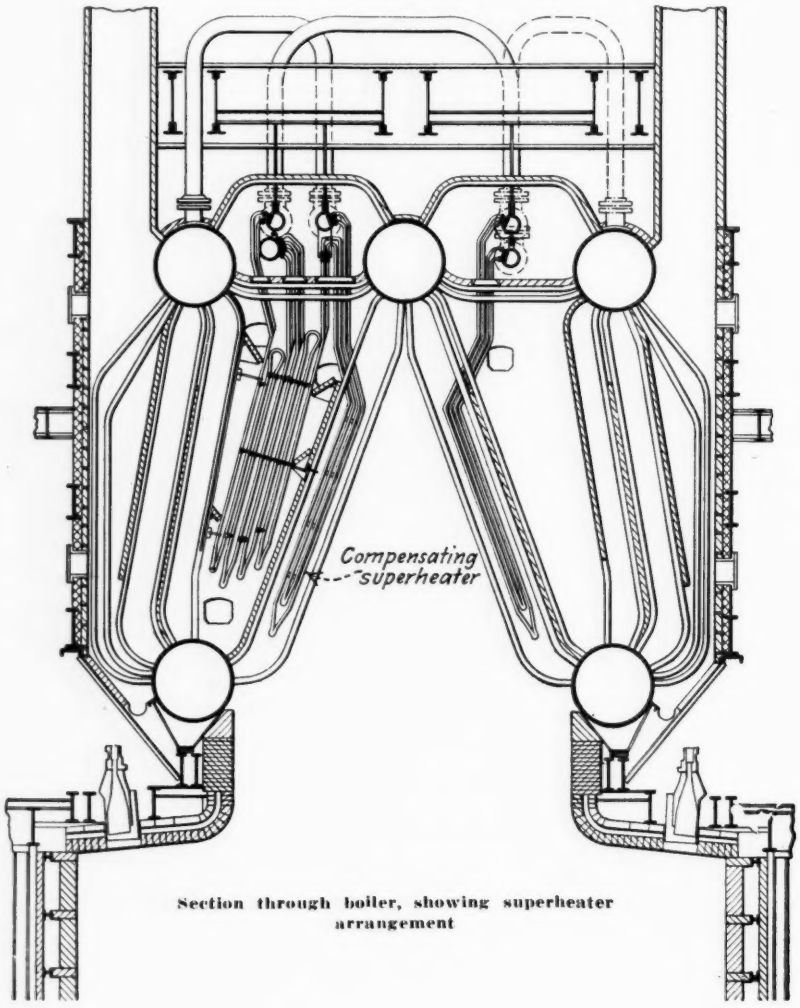
# Compensating Superheaters

By P. W. THOMPSON
*Detroit Edison Co.*

A SUPERHEATER that will deliver steam at practically constant temperature over a wide range of boiler rating has long been sought by the power plant designing engineer. Two superheaters which it is believed will fulfill this specification are being built by the Superheater Company to be installed in two of the type W Stirling boilers in the Trenton Channel station of the Detroit Edison Company.

The unit consists of two semi-radiant sections in parallel, one on each side of the boiler nested in between the front five rows of boiler tubes. Each discharges its steam through convection loops (three loops in series with each radiant section), all on one side of the boiler. By adjusting the dampers on the two gas outlets from the boiler it is possible to vary the quantity of gas passing over the convection surface in such a manner as to produce a greater heat absorption in the superheater at low ratings than would result if the furnace gases were equally divided between the two sides of the boiler.

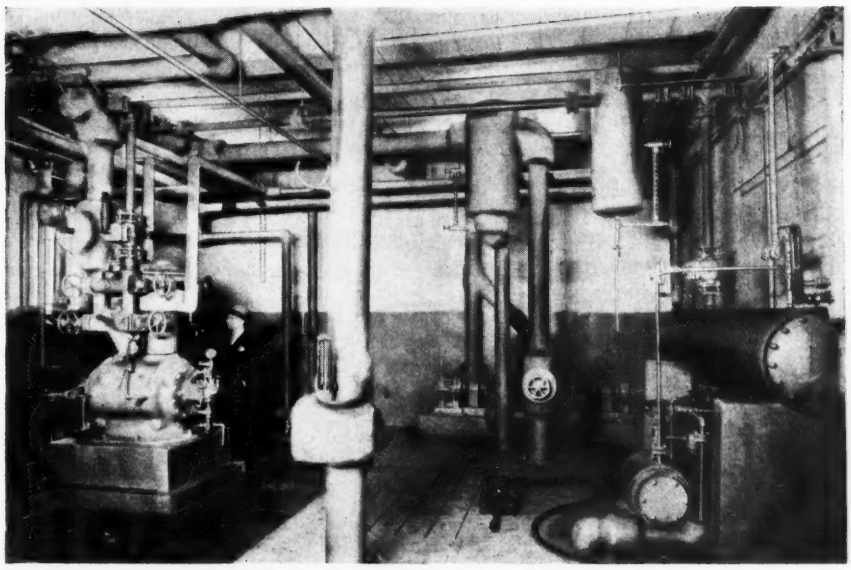



Section through boiler, showing superheater arrangement

The inherent characteristics of the radiant sections assist in keeping the superheat up to normal at low ratings, but without the compensating effect resulting from the controllable unbalanced gas flow over the convection sections. It has heretofore been impossible to produce a superheater that would maintain its flat characteristics over a wide range of steaming rates.

Preliminary experiments, the results of which were used in the design of these superheaters, were conducted upon a trial installation of a few superheater units arranged as described above, in one of the type W boilers at the Marysville station of the Detroit Edison Company.

The installation at Trenton Channel is not yet complete, so no results can as yet be given. These together with a description of the arrangement, will be given in an article which will appear in *Power* at a later date.



Neatly arranged piping adds to ease of operation as well as appearance

# Practical Suggestions for Refrigeration Piping

**The working substance of refrigerating systems is in most cases irritating, noxious and even deadly, so that more than ordinary care should be taken in erection and design to insure a tight piping system. This article points out some pitfalls to be avoided and discusses automatic control devices**

By LEON BUEHLER, Jr.
*Frick Company, Waynesboro, Pa.*

FROM THE viewpoint of operating economy, prevention of leaks is most important, for a leak here not only represents lost power, but a waste of expensive chemicals that must be replaced. The prevention of leaks is considered so important by a large manufacturer of ice that substantial prizes are awarded annually to the operators of plants consuming the least ammonia in relation to their size.

The pressures carried in refrigerating plants vary from a vacuum to as high as 1,250 lb. per square inch, depending upon the refrigerant used and the operating temperatures. The Safety Code for Mechanical Refrigeration specifies "The minimum strength of connecting pipes shall be as follows:

"(*a*) Standard-weight butt-welded pipe may be used for test pressures not exceeding 150 lb. Extra-heavy butt-welded pipe must be used for higher test pressures.

"(*b*) Lap-welded standard weight pipe or seamless tubing of the same size may be used for test pressures not exceeding 300 lb. Extra-heavy sizes must be used for higher test pressures."

This same code specifies the following test pressures:

| Refrigerant | High-Pressure Side (Lb. per Sq.In.) | Low-Pressure Side (Lb. per Sq.In.) |
|---|---|---|
| Carbon dioxide | 1,500 | 750 |
| Ethane | 1,110 | 550 |
| Ammonia | 300 | 125 |
| Propane | 250 | 125 |
| Methyl chloride | 175 | 125 |
| Sulphur dioxide | 135 | 100 |
| Isobutane | 135 | 100 |
| Butane | 100 | 50 |
| Ethyl chloride | 100 | 50 |
| Dichloromethane | 15 | 15 |
| Dichloroethylene | 15 | 15 |
| Trichloroethylene | 15 | 15 |

The materials used in piping systems depend upon the refrigerant employed. Ammonia, the most common in large installations, attacks most non-ferrous metals, so that iron pipe and fittings are exclusively used. If galvanized pipe is used it should be black on the inside. With carbon dioxide iron pipe is also employed, because it is least expensive. These are the two most widely used refrigerants. F-12, a newly discovered substance for this purpose, may also be used with iron pipe.

Pipe joints other than those made by flanges or unions may be either screwed or welded. Cinch fittings or soldered joints are permissible on very small tubing. Flanged fittings subject to working pressures over 100 lb. should be of the recessed-gasket type. For carbon dioxide one type of flange makes the joint with a gasket between the ends of the pipe, so that the pipe threads need not be gas tight.

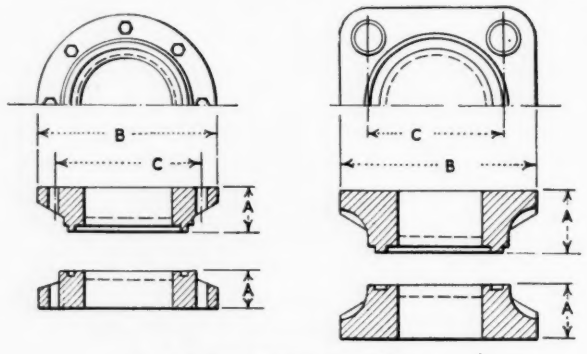
There is no dimensional standard for flanges and fittings. The table illustrates a representative line which has been proved by years of use. Fittings of different manufacturers are in general not interchangeable. Since refrigerants are quite difficult to confine, they should be made of close-grained semi-steel, or wrought iron, and regardless of the material must not be porous. The valves are especially important, and the buyer should assure himself that the valves will not only close tightly when new but will still seat after repeated openings. Before making a repair the mechanic who will be exposed to the danger and annoyance from leaking gas prays that the valves will hold. Unfortunately, many valves are unreliable.

Certain precautions must be taken in making screwed joints. The threads should be to size and perfect. Torn threads due to dull dies are sure to give trouble. Screwed joints should be carefully cleaned both on the pipe and fitting. Gasoline serves well to remove oil, but it should be carefully dried off. The pipe and fitting should be screwed tightly together, using a compound of litharge and glycerine to coat the thread. Other compounds not attacked by the refrigerant may serve equally well. As an alternate the sweat-soldered joint may be substituted. In this case the threads should be cleaned as before, and in addition a solution of muriatic acid and water is brushed on the threads of the pipe and fitting. Both the pipe and fitting are then heated in molten solder and while hot are screwed together tightly. The fitting should be recessed and an extra amount of solder is poured into the recess while the fitting is still hot. Some engineers prefer this type of joint, but I can see no advantage to justify the expense. Calking of leaky joints should not be tolerated.

Welding makes a very satisfactory joint when done by expert workmen. The joints must, of course, be made of liberal strength. Welded joints are specified in detail in codes and there has been so much already written on this subject that further discussion will be omitted.

For carbon dioxide, copper or hard fiber is employed in gaskets. For ammonia, lead, rubber or fiber gaskets are satisfactory. It is well to soak fiber gaskets in oil before using.

The entire system should be tested and made tight at the pressures previously specified for the various refrigerants. Air is used for testing. It is advisable to build up the pressure in steps, inspecting all joints at each pressure step. Soap suds painted on the joints will indicate leaks by bubbling. After the air test the system may be charged. It is well to charge only a little gas into the system at first and make a further inspection. Ammonia is readily detected by its odor, but it is difficult at times to locate the exact point of the leak. Burning a sulphur taper near the suspected leak will give dense white fumes near the point of escaping gas. Ammonia is a similar indicator for sulphur dioxide. Carbon dioxide may be scented with peppermint to indicate leaks. As charging progresses and the low side gets cold, while the high side heats, a further inspection should be made, for the temperature changes may cause new leaks. To repair thread leaks the pipe should be removed from the line and the joint made up new. Pipe leaking in the seam should be discarded, as welding over the surface will not impart strength to a weak seam. Pin holes in welded joints may be repaired by welding, but where a large percentage of the joint is porous it should be cut out and replaced.




**Ammonia Flange Dimensions**

Inches

| Nominal Pipe Size, In. | A | B | C | Bolts |
|---|---|---|---|---|
| | | ROUND | | |
| 5 | 1 13/16 | 10 1/4 | 8 1/2 | 8–3/4x4 1/2 |
| 6 | 2 1/16 | 11 1/2 | 9 1/2 | 8–3/4x5 1/4 |
| 7 | 2 1/16 | 13 1/2 | 11 1/4 | 8–3/4x5 3/4 |
| 8 | 2 1/16 | 14 1/2 | 12 1/2 | 8–3/4x5 1/2 |
| 10 | 2 1/4 | 17 | 15 | 12–3/4x5 3/4 |
| 12 | 2 1/4 | 18 3/4 | 16 1/2 | 12–3/4x6 1/4 |
| | | SQUARE | | |
| 1 1/4 | 1 1/4 | 3 1/4 | 2 1/4 | 4–1/2x3 |
| 1 1/2 | 1 3/16 | 4 | 2 1/2 | 4–1/2x3 1/4 |
| 2 | 1 1/2 | 4 1/2 | 3 1/16 | 4–1/2x3 1/4 |
| 2 1/2 | 1 1/2 | 5 1/2 | 3 13/16 | 4–1/2x4 |
| 3 | 1 1/2 | 6 1/4 | 4 1/8 | 4–1/2x4 1/4 |
| 3 1/2 | 1 1/2 | 6 1/2 | 4 7/16 | 4–1/2x4 1/2 |
| 4 | 1 1/2 | 7 1/4 | 5 | 4–1/2x4 3/4 |

## Erection and Insulation of Piping

All piping should be supported in a substantial and workmanlike manner, rigidly enough to prevent excessive vibration. Where quiet operation is essential, hangers should not be attached to structural members, which will transmit pulsations through the building. In such cases piping is frequently supported on cork mats or other resilient material. Insulated pipes should be carried on sheet-metal shields between the insulation and the hanger. The shield must be large enough to prevent crushing or excessive compression of the insulation.

In erecting piping to be insulated, the pipes must be kept far enough from walls and other obstructions to allow for insulation. In applying insulation to cold pipes the surface of the covering must be carefully waterproofed. The deposit of moisture on cold surfaces, like the sweating of a glass of ice water, is well known to everyone. Not only does moisture in insulation increase its conductivity, but if the pipe is at or below freezing temperature this moisture will freeze, tearing or crumbling the insulation and rapidly destroying it. Poor waterproofing is the cause of practically all insulation failures in refrigerating work.

The connecting piping of the refrigerating plant consists of high-pressure gas lines, high-pressure liquid lines, low-pressure liquid lines (which usually carry also some gas) and low-pressure gas lines. These are also known as discharge lines, liquid lines and suction lines.

It is usual practice to limit gas velocities in the suction line to 4,000 ft. per minute and in the discharge line to 6,000 ft. These figures apply for ammonia. For carbon dioxide the limiting velocity is about 1,200 ft. Carbon dioxide is so very heavy that high gas velocities cause excessive vibration of piping; hence the lower values. These are not true velocities, but are based on the volume of gas pumped at suction pressure.

Reed and Ambrosius[1] give experimental data on the pressure drop of superheated ammonia vapor flowing

[1] *Refrigerating Engineering*, February, 1930.

through pipes. The curves for determining pressure drop are plotted from the formulas they developed and represent values applicable to both suction and discharge lines. Actually the values are not constant for all pressures and temperatures, but the difference is too small to affect computations seriously and the single value is given to avoid complications. Fittings add approximately the following equivalent lengths of pipe:

| | Ft. |
|---|---|
| 90-deg. elbows | 40 |
| Globe valves | 60 |
| Tees | 60 |
| 90-deg. curves | 20 |
| Square ells | 50 |

Especially with small pipes and long lines it is well to keep the velocities considerably lower than 4,000 and 6,000 ft. per minute.

The limiting velocities for liquid lines are between 150 and 250 ft. The liquid drain line from the condenser to the receiver should not exceed the 150 ft. velocity, as gas must return from the receiver to the condenser through this line as well, unless an equalizing line is provided from the top of the receiver to the condenser. Where the liquid line is long it should be made one or two pipe sizes larger. This liquid drain line should slope toward the receiver, or at least it should not slope the other way, forming a trap preventing the return of gas. If the gas is not relieved from the receiver liquid will not drain from the condenser. While some gas is carried along with the liquid in the low-pressure liquid line, it is usually not necessary to increase the size, as a large pressure reduction occurs at this point anyway and part of this reduction may just as well take place in the line. If, however, the line is long, say over 20 ft., it is well to increase it one pipe size.

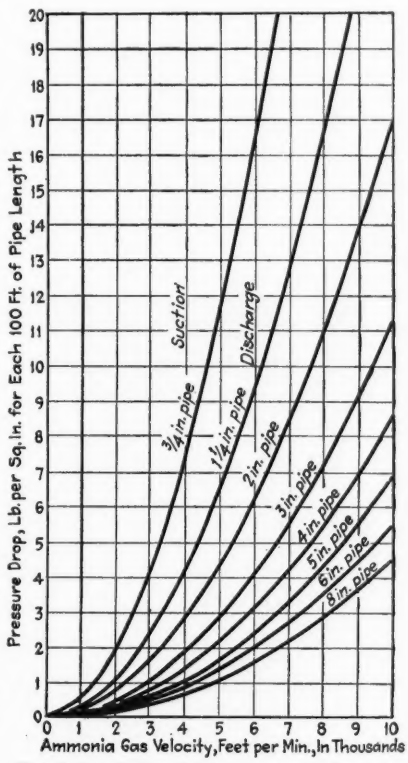


**Chart for determining pressure drop in ammonia lines**

Traps are to be avoided in suction lines, as liquid may collect in the low points, creating a seal and resulting in periodic slugs of liquid returning to the compressor. Liquid going to the compressor is not only inefficient, but also may cause considerable damage as it imposes an extra strain on the compressor.

If a number of compressors are used the suction line should not pass directly over them with the suction dropping straight down from the line, but there should be a short horizontal run from the main line to each machine before dropping.

Good practice calls for a check valve in the discharge line from each compressor ahead of the main line to prevent gas flowing back into the compressor while shut down. Without this valve liquid may condense in dangerous quantities in the machine during shut down, which may be the cause of an accident on starting. The check valve should be provided with a means of raising the valve off the seat or it should have a bypass.

The expansion valve may be manually operated, but it then requires frequent adjustment to meet changing load conditions. There are many types of automatic valves operating on various principles.

### Automatic Controls

The so-called automatic expansion valve maintains a constant outlet pressure. The outlet pressure is balanced through a diaphragm with a spring between outlet pressure and atmospheric pressure. An adjustment is provided to set accurately the outlet pressure, which will be the pressure carried on the low side. The low pressure carried should be as high as possible consistent with the cooling temperature without returning liquid to the compressor. If the cooling temperature remains constant, the automatic expansion valve works efficiently, but unfortunately this is usually not the case. For instance, a refrigerator may be allowed to fluctuate between 40 and 50 deg. The valve must then be set to operate at the lower temperature, and at the higher temperature it will be inefficient.

To overcome the objection to the automatic expansion valve, the thermostatic expansion valve was developed. Here the pressure in the suction line is balanced against the temperature of the suction gas through the pressure of some of the refrigerant contained in a bulb. A spring adjustment is provided to set the pressure and temperature difference to any desired value. The valve really maintains a constant superheat in the suction gas. The valve itself is in the liquid line controlling the amount of liquid fed to the low side. For many applications this valve is very satisfactory. With widely fluctuating loads or where it is necessary to keep the superheat to a minimum, like on an ice-making tank, the valve is not sensitive or quick-acting enough.

One of the most satisfactory controls is the float valve. This is nothing more than a float inclosed in a case and operating a throttle valve. It is employed in two distinct ways, the simplest of which is to trap all of the liquid refrigerant into the low side. In this form it may be compared to the drain trap, which is open as long as there is liquid in the case to raise the ball but which closes as the liquid empties. The float valve then simply forms a liquid seal preventing high-pressure gas from passing to the low side. The high side contains only gas, and the liquid receiver is superfluous. The system is charged with the correct amount of refrigerant. To provide for some leeway in the proper quantity and to take care of changing load conditions an accumulator or separator is installed at the outlet from the cooling coils, this vessel acting also as a storage drum. This system works well when there is only one cooler or when there are a number of small refrigerators which can be connected in series. It cannot be used when there are a number of coolers connected in parallel, which is usually the case in the larger, more complicated plants.

The float can also be used to control the liquid feed to an individual cooler independently of other coolers. In this case it controls the liquid level. The valve opens when the level drops below a predetermined level and

closes when this is exceeded. This method works well when properly installed, but the correct method is not always so obvious. In many cases, particularly where there is a high gas velocity through the cooler, there is no well-defined liquid level in the cooler which the control can maintain. In such cases a separate drum is provided in which the liquid is held at a given point and the liquid circulates from this drum through the cooler. Sometimes this circulation can be accomplished by gravity and in other cases a pump must be provided to circulate the liquid. In attempting to control liquid level the inexperienced will do well to call an expert.

Solenoid or electric-motor-operated valves are frequently used to cut off the liquid supply to a cooler or to act as a bypass in series systems. These valves are usually operated by a thermostat, but may be used with a float switch, or for that matter with any control device which may be desired for a given application.

Frequently, back-pressure valves are connected in the outlet from a cooler. These valves prevent the pressure in the cooler from dropping below a predetermined minimum. They are usually used with one of the valves described above controlling the liquid inlet. One application is in preventing a water cooler from freezing. The back-pressure valve is set for a pressure at which the refrigerant is slightly above freezing. Another application is where one cooler is to be run at high temperature while the balance of the system operates at low temperature.

Compressors are frequently driven by synchronous motors. These motors do not have sufficiently high starting torque to turn over the compressor unless the suction and discharge pressures have first been equalized. The pressures are usually equalized manually, but there are several automatic devices on the market to accomplish this. A check valve is provided in the discharge line to prevent the high pressure from coming back on the machine. When the compressor starts a valve opens between the suction and discharge of the compressor and remains open until the motor is up to speed.

Fully automatic control of refrigerating plants is not new. Only recently has it been possible automatically to control other than the smallest plants. Today the only limitation is the feasibility of controlling the entire process in connection with which the refrigerating plant works. Even where the entire process cannot be controlled without some supervision it is usually desirable to have a partial automatic control. The robot can adjust itself so much more quickly and accurately than a man can follow fluctuations that these controls quickly pay for themselves in increased efficiency alone, to say nothing of the labor saved.

▼ ▼ ▼

# Electric Steam Generator Supplies Peak Loads

By M. G. SANDERS
*Mechanical Superintendent*
*Aluminum Company of Canada, Ltd.*
*Arvida, Que.*

WHENEVER large blocks of electric power are contracted for by a manufacturer there are sure to develop periods, often of long duration, when the purchaser has surplus power over the process requirements which in many cases can be used to advantage to help generate the steam requirements of his plant. The Aluminum Company of Canada, among others, has not escaped this situation, and in 1926 at its Arvida works installed a single-tank manually operated steam generator of the Kaelin type. In this type boiler steam is generated by the passage of current through the water, which acts as a resistor. This boiler has a rated capacity of 8,000-kw. at 2,200 volts.

During the next two years another division of the works was built which required, among other small amounts of process steam, from 450 to 1,500 lb. to be used in from 3 to 7 min. every 4 hr. This was supplied from another boiler house, but after a year's experience it was felt that the electric boiler would supply all process load during summer months at a considerable saving if some way could be found to handle the peak load satisfactorily. The normal summer load on the boiler was 6,000 to 10,000 lb. of steam per hour, consequently the peak meant at least 100 per cent increase.

The first method followed was for the production department to give a signal about 20 min. in advance of when they required steam, a second signal immediately before it was turned on and a third when it was turned off. On receipt of the first signal the operator would raise the water level in the boiler and try to have the steam pressure as high as possible, without the safety valves lifting, when steam was called for. If the pressure fell rapidly under increased load the operator

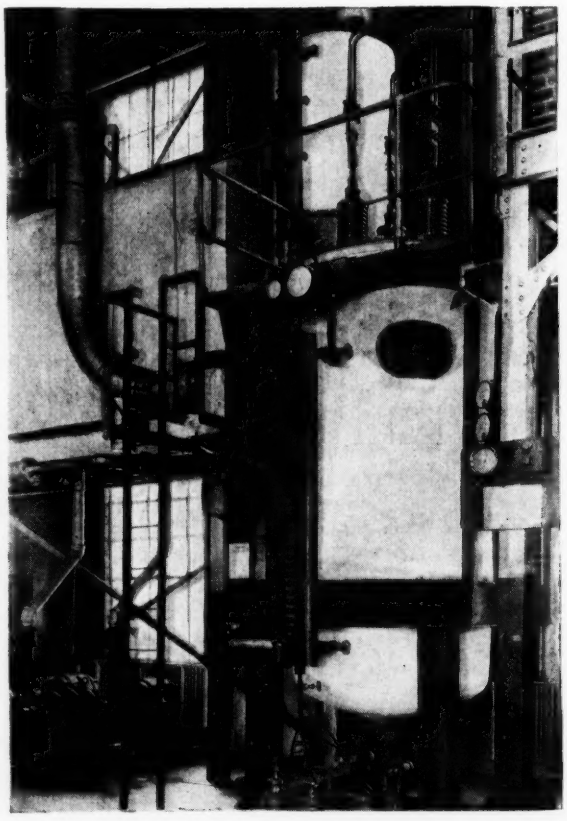


**Fig. 1—Manually controlled electric steam generator rated at 8,000 kw. that supplies sudden peak demands**

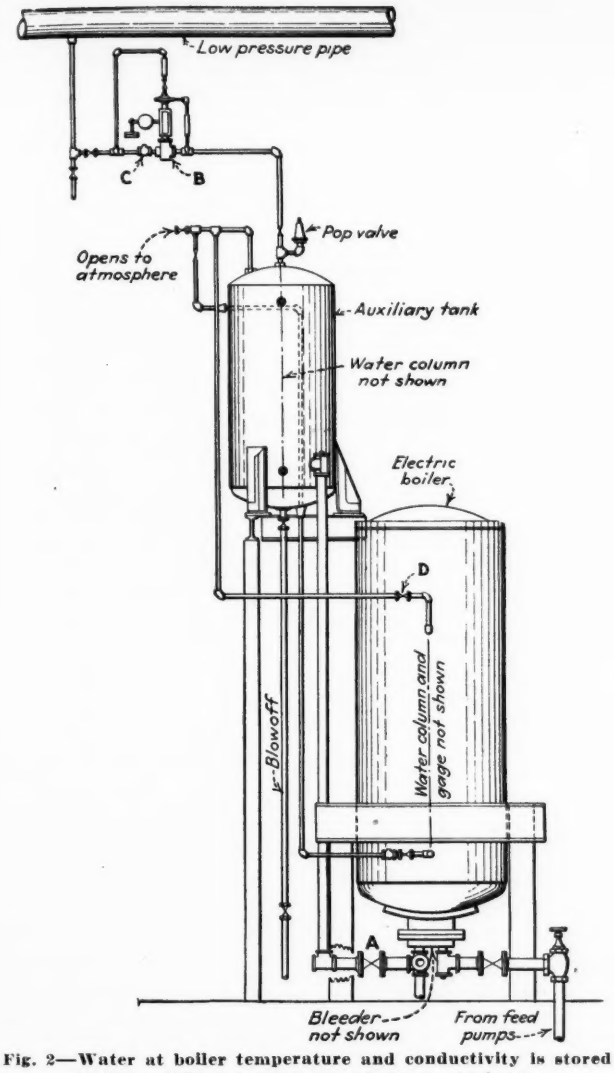



**Fig. 2—Water at boiler temperature and conductivity is stored in the auxiliary tank for use during peak loads**

increased the conductivity of the water in the boiler by adding soda ash to the feed water, which allowed the load to pick up at once to the required amount. This, however, required reducing the conductivity of the boiler water by bleeding after the peak load had passed. As the operating department could not always judge the time of demand accurately, the boiler would usually pop before the load came on or it would not be ready in time.

In an attempt to improve boiler operating conditions it was suggested a sufficient quantity of water of the same conductivity and temperature as that in the boiler be made available. This water was to be stored in a separate tank from the regular feed water so that it could be injected into the boiler as the demand for steam arose. It was believed that if this could be done no difficulty would be experienced in supplying any steam demand within the capacity of the boiler. Further, when the demand was over, if this excess water could be drained from the boiler and stored, it would be available for other peak loads and would prevent the bleeding necessary under ordinary conditions. Figs. 1 and 2 show the installation as made to accomplish this purpose, which consisted of an auxiliary tank for holding a reserve supply of properly conditioned feed water connected to the boiler as in Fig. 2. The operation is as follows:

Suppose the auxiliary tank to be nearly empty and the water level in the boiler to be high at the end of a large demand for steam. As soon as steam pressure in the boiler begins to rise above normal, valve *A* is opened and valve *D* closed, allowing the steam pressure to force water from the boiler into the auxiliary tank. This continues until the water level in the boiler is just sufficient to draw the necessary current to meet normal operating demands, when valve *A* is closed. Valve *B* allows low-pressure steam and vapor to escape into a large steam line, which normally operates at a pressure considerably below that of the boiler. This valve is of a type which will close when the pressure in the auxiliary tank rises above that in the steam line. *C* is a check valve which prevents back flow.

This arrangement gives a supply of feed water in the auxiliary tank of about the same conductivity as that in the boiler, kept warm by a steam coil as well as by steam on top of the tank admitted through valve *D* which is opened as soon as the water level in the boiler is established. When the boiler operator is notified that the next peak load is due valve *A* is opened and boiler pressure on top of the water in the auxiliary tank, in addition to the differential pressure between the auxiliary tank and the boiler, causes the water level in the boiler to rise rapidly and quickly increases the boiler's steaming capacity. When the water level reaches the desired height valve *A* is closed. The cycle can be repeated as often as required without the necessity of bleeding the boiler or having the safety valves to operate on account of temporary peak loads.

In order that the operator keep the proper water level in the boiler for any given load and thus prevent the danger of generating hydrogen, a scale was placed on the water column to show the load, both in boiler horsepower and amperes, that should be carried for any water level. One side of the scale shows water levels for normal operation and the other the safe limit that can be allowed for larger loads of short duration. By checking the water level with the input ammeter the operator is always able to maintain the former at the proper height. It has been found that this method of operation practically eliminates pitting on the lower boiler head and on the inside of the shell, which had given trouble in the early days of operation.

The maintenance on this boiler consists of removing the head, cleaning the electrodes spring and fall, cleaning the inside of the boiler and the overhaul of feed, bleed and blow-off valves.

The boiler operated at an average of 40 per cent of rated capacity during 1931, at a cost for maintenance of $0.0126 per 1,000 lb. steam, which included a complete overhaul and test and the replacement of all electrode bushings. The efficiency has always been better than the makers guarantee, and since the problems previously described have been settled, boiler operation has given no trouble.

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THE last sentence of the article "Industrial-Plant Synchronous Condensers Automatically Controlled" in April 12, number, read: "There is question as to the suitability or reliability of automatic control, for it has proved itself dependable throughout many years of service." This statement should have read: "There can be no question as to the suitability or reliability of automatic control, for it has proved itself dependable throughout many years of service."

# Atomization Reduces Oil in Exhaust Steam

**Correctly designed "quill," properly located and protected, will produce a mist of oil, which will deposit on moving parts of the engine and leave a fairly clean exhaust**

By JAMES I. CLOWER

IN GENERAL, oil is objectionable in exhaust steam, because of its tendency to foul pipes, heating coils, feed-water heaters and especially boilers. Not only does oil in the exhaust steam cause the formation of oily films and deposits on the tubes, thereby materially reducing the rate of heat transfer, but also it may cause the boiler to foam and prime.

While many excellent and efficient oil separators and grease extractors are on the market, yet a prevention is, in general, better than a cure. Hence it is desirable to adopt a lubrication practice that will insure a minimum feed of cylinder oil consistent with safe and efficient lubrication.

As a whole, it is doubtful if steam engineers realize the full significance of providing a lubrication system capable of supplying steam cylinder oil in the small uniform quantity usually required. More especially, they do not realize the importance and advantages of so locating the oil feeds as to insure thorough and uniform distribution of the oil over the rubbing surfaces.

### Oil Distribution

Oil distribution is mainly dependent upon two factors, the oil and the method of application. It is not the purpose of this article to discuss the first of these two factors.

Three methods of applying oil to steam cylinders are employed:

1. Direct application to the cylinder and valve; i.e., the oil-feed lines from the lubricator deliver oil direct to the cylinder wall and valve chest.
2. Simple injection into the steam line (see Fig. 1), or steam chest, without providing any special means of distributing the oil.
3. Injection into the steam pipe in conjunction with an atomizer, which breaks the oil drops into a very fine mist or spray (see Fig. 1).

### Direct Application

When direct application is employed, the moving parts are depended upon to distribute the oil over the valve seat, cylinder wall, piston rod and valve stem. Obviously, to effect thorough distribution, oil must be injected at many points around the cylinder and into the valve chest. Even then efficient distribution is not always attained, unless considerable quantities of oil are fed. In consequence, relatively large amounts of oil are frequently found in the exhaust where direct application is practiced.

However, under certain operating conditions, and in the case of steam-jacketed cylinder heads, direct application is necessary. In under-loaded engines (less than 75 per cent of rated capacity), atomization is not thorough due to the lazy, sluggish action of the steam, hence direct application is required. The use of steam at very high superheat also calls for direct application, because of the detrimental influence of high temperature upon oil in an

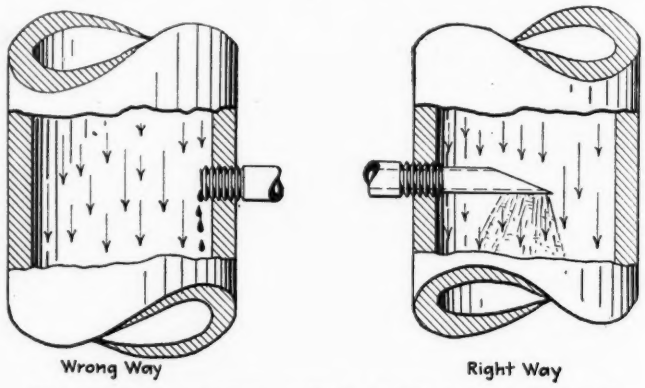



**Fig. 1—Right and wrong methods of introducing cylinder oil into the steam line**

atomized state. Steam jacketed cylinder heads such as are found on most uniflow engines, trap the oil, preventing it from entering the cylinder.

### Simple Injection

Rarely if ever is it necessary to use the simple-injection method of oil application. It requires an excessive feed to secure thorough distribution, resulting not only in a waste of oil, but in the discharge of large quantities of oil with the exhaust. Moreover, the excess oil tends to

cause operating difficulties by forming carbon deposits, which accumulate behind the piston rings, interfering with their proper functioning. If the feed pipe just penetrates the wall of the steam line, the oil runs down the inside of the pipe in rather large drops, as shown at the left in Fig. 1.

### Injection with Atomizer

Injection into the center of the steam line through an atomizer is shown at the right in Fig. 1. Atomization of steam cylinder oil is attained by the impact of steam, which forces the oil thorough small, narrow slots or drill doles in the end of a spoon-shaped quill. The oil in passing through the slots or holes is broken into very small

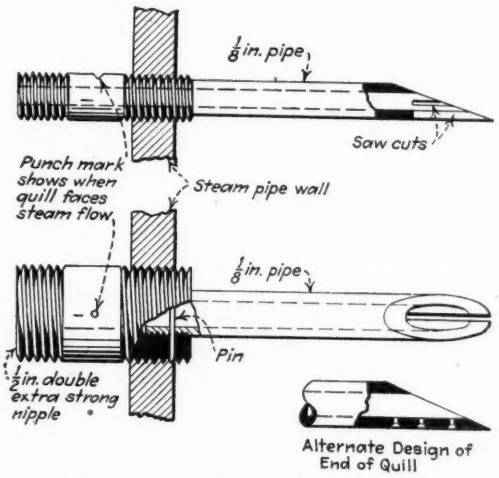

⅛ in. pipe
Saw cuts
Punch mark shows when quill faces steam flow
Steam pipe wall
⅛ in. pipe
Pin
½ in. double extra strong nipple
Alternate Design of End of Quill

**Fig. 2—One- and two-piece atomizers**

particles or a spray and intimately mixed with the steam. It is thus carried by the steam to all internal rubbing surfaces of the engine.

With atomization, efficient lubrication is obtainable with a minimum rate of feed and a consequent reduction in the amount of oil in the exhaust steam. Frequently, it is found possible to reduce the feed by half when a suitable atomizer is installed in place of a simple injection pipe, and at the same time decrease the amount of oil in the exhaust to a point where it is no longer a problem.

The argument has been advanced that atomization is very inefficient due to the thorough mixing of the oil and steam, resulting in a large percentage of the oil passing through the cylinder without having acted as a lubricant. Experience has demonstrated that such does not actually happen. The explanation is, that due to the turbulence of the steam in passing through the ports, the oil particles, which appear to attach themselves to any moisture that may be in the steam, are thrown outward by centrifugal force against the metal surfaces.

### Atomizers

Neither is an elaborate shop nor are expensive materials required to make an efficient and reliable atomizer. Two simple designs that can be made on the job are shown in Fig. 2.

For saturated steam, it is recommended that the quill be made of ⅛-in. Delta-metal pipe, which is a metal bronze of high enduring quality and consequently free from oxidation. For superheated steam, a non-rusting steel quill has proven excellent.

Experience has demonstrated that a small-bore pipe, in general, gives better service than a large one. Where the feed is small and a large-bore quill is employed, the oil remains in the quill for some time before being atomized. Thus the oil is exposed for some time to the high heat of the steam, thereby becoming carbonized. Not infrequently deposits are formed which clog the quill, requiring its removal for cleaning.

On the other hand, the oil flows through a small-bore quill at a much greater rate and hence is not exposed to the heat of the steam for any appreciable time. For this reason, the tendency for the oil to carbonize and clog small bore quills is not as great as it is for large quills.

### Installation and Protection

Regardless of the size of the bore, quills should be removed and cleaned approximately every six months. The exact length of time, of course, depends upon the cleanliness of the steam. To facilitate the removal of the quill, the threads should be turned, filed or ground from that portion extending into the steam pipe; otherwise its removal may be difficult because of rusted threads.

In atomizers of the two-piece type, the quill should be securely fastened in the nipple by a pin riveted in place as shown below in Fig. 2. Cases could be cited where considerable damage was done by the quill working loose, due to vibration, and falling into the valve.

Iron or steel piping is not recommended for oil leads from the lubricator, because of its tendency to rust and scale, which may clog the terminal check valve or some other part of the oil delivery line.

In all cases a terminal check valve should be installed at the extreme end of the feed pipe, close to the atomizer as shown in Fig. 3. A check valve not only prevents any steam from entering the oil pipe, but also maintains the pipe full of oil at all times, insuring that oil is available as soon as the engine starts.

Experience has demonstrated that the atomizer should be located some distance (four or five feet is generally sufficient) back of the throttle valve. It should not, however, be placed beyond an elbow, a separator, or any other fitting that would tend to cause the oil to separate from the steam.

Care must be exercised when installing an atomizer to make certain that the cut-away portion of the quill

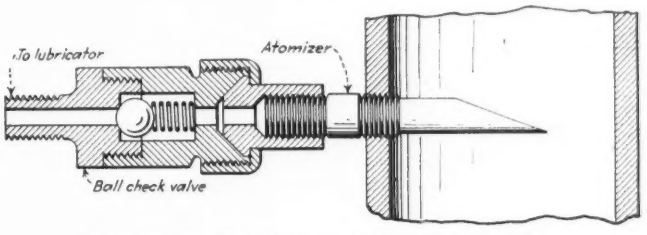



**Fig. 3—Terminal ball check valve and atomizer**

faces the steam flow. A punch or file mark made on the quill as shown in Fig. 2 will be of much help in properly locating the quill.

Where atomizers are installed in horizontal steam lines, they may be placed either vertical or horizontal. If placed vertically, however, the quill should be on top of the pipe so the oil flow will be downward.

While the use of an atomizer in conjunction with a properly designed mechanical force-feed lubricator and the correct oil for the service may not in all cases entirely eliminate trouble arising from oil in the exhaust, yet it is certain that in many cases relief can be secured in this way.

# Load Limited Automatically On Direct-Current Generators

By ROBERT R. LONGWELL

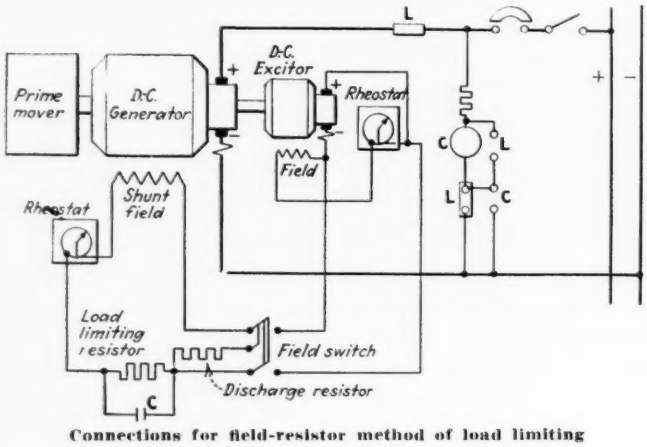
*Switchboard Engineer*
*Westinghouse Electric & Mfg. Company*

ON MANY installations of direct-current generators it is often desirable to add equipment for automatically limiting the load current that may be taken from the unit. This is necessary in order to prevent overloading of a generator thermally, or in an amount which would cause the unit to be disconnected from the bus by overload relays. By limiting the load on a machine it may be maintained in service during transient periods of overload, thus ensuring the maximum system generating capacity for the emergency or until another generator can be started.

In industrial plants continuity of service is of utmost importance, and continuous power supply, during peak loads, must be maintained even though the system voltage may be reduced slightly. Where separately excited generators with shunt field windings are used, this operation of automatically limiting the load on a generator may be easily and economically accomplished. The only extra equipment required consists of a small adjustable shunt-field resistor, a small resistor-shunting contactor and a load-indicating relay.

The resistor is connected in the generator shunt-field circuit as in the figure and adjusted to cause the required reduction in generator terminal voltage to limit the load on the unit to a satisfactory value with average system conditions. The contactor is so connected that when energized it will shunt this resistor with its main contacts. The load-indicating relay is used to energize or deenergize the contactor, as load conditions demand.

During normal operation the generator terminal voltage is at the rated value, with the load-limiting resistor shunted out of the circuit by contactor *C*. When the load on the unit reaches a predetermined maximum value the load-indicating relay *L* operates to deenergize the load-limiting resistor shunting contactor. This operation inserts a fixed amount of resistance in the generator shunt-field circuit, thereby causing the terminal voltage to be reduced. Reduction in terminal voltage will permit units in other substations or generating plants to assume a greater portion of the load, thus relieving the overloaded machine. This reduction of voltage at one station causes other generating plants to take load in the same manner that reducing the terminal voltage of one generator causes other generators in the same station to take the load.




**Connections for field-resistor method of load limiting**

Many generators are designed to carry 150 per cent of normal rated load for two hours and 200 per cent load for one minute. With such a generator having thermal protection, the load-indicating relay *L* may be set to deenergize resistor-shunting contactor *C* at about 200 per cent load rating on the generator. The field resistor should be adjusted to reduce the terminal voltage in an amount which will shift 25 per cent of the load to other machines on the system. With this arrangement a generator can operate for a considerable period of time without any danger of damage occurring to windings through overheating, even though the load is not maintained at exactly 150 per cent.

When load conditions return to a normal value, load-indicating relay *L* will allow reclosing of the resistor-shunting contactor at a load value of approximately 140 per cent on the machine. These values are typical for certain applications, but the description serves to illustrate how the equipment may be applied. Steel mills, industrial plants, railways and many other types of service can make use of the same system by varying the relay setting and resistor calibration.

The operation is smooth, effective and reliable where proper consideration is given to the various phases of the application. Due to the inherent characteristics of the generator no sudden change in voltage takes place when the resistance is inserted in or cut out of the field circuit and no bump is noticeable on the system. If necessary, in order to prevent reverse current on the generator where load changes are sudden, the generator field circuit may be overshot momentarily to facilitate in the recovery of voltage. If this feature is considered necessary, all shunt-field resistance (rheostat and any other resistance) can be short-circuited for the instant required for complete recovery of voltage and thus prevent reverse current from tripping the generator off the line.

This method of load limiting is being used on several installations with complete success. It has many advantages over the old method of inserting a block of resistance in the main circuit between the generator terminals and the station bus. Some of these advantages are: Low first cost, small space required, ease of adjustment, lack of insulating problems and economy in operation. As an example, on an installation using 2,000-kw. generators operating at 3,000 volts, the watts loss in grids, when connected in the circuit for load limiting, would have been 90 kw., whereas with the field-resistance method the loss is only 1.5 kw.

The amount of equipment necessary to accomplish this simple but important operation is so small that it may be added to an existing installation with only slight expense and a few minutes' interruption of service. Even though the grid-resistance method of load limiting is now being used, it will prove advantageous to change to the shunt-field method where possible, due to the superior operation obtained.

It is to be understood that the field-resistance method of loading limiting is only applicable to separately excited generators. Obviously, this scheme will not apply to synchronous converters or mercury-arc rectifiers and is not recommended for use with self-excited generators, due to the possibility of unstable operation.

# PRACTICAL AIDS TO OPERATION

## A Difficult Foundation Job

SOME TIME AGO we sold a 200-hp., 460-r.p.m. vertical diesel engine and generator to operate in parallel with an existing water-power plant. The engine was sold with the understanding that we put in the foundation and assume all responsibility.

On going to the site to lay out the foundation, we found it to be 200 ft. down an embankment on the side of a small river, close to the dam. We sank a test hole, or tried to, for after digging 6 ft. down the hole filled with water; rods were obtained and forced down 25 ft. by hand with ease. We endeavored to have the site of the engine changed and operated by remote control, but the purchasers refused and insisted that we keep to our contract.

Eventually it was decided to construct a mattress, as piling was prohibitive. We excavated and pumped the material (a water-logged sandy loam) from a hole 60 ft. by 40 ft. by 10 ft. deep, preventing the hillside from coming into the hole by sinking large stones and brush wood as we went down. It was a difficult job and we were discouraged several times, when a stone weighing ½ ton went out of sight almost as soon as it was rolled in. Eventually severe frost came, which helped matters, and we were able to get a brush and stone layer over the whole area, about 6 ft. thick, with a concrete top of 4 ft. I might add that before placing the concrete we laid 6-in. tile around the outer edge and through the center to take off spring water and seepage from the hill. A standard foundation was then built for the engine.

When the installation was finally completed the engine operated satisfactorily and vibration was negligible.

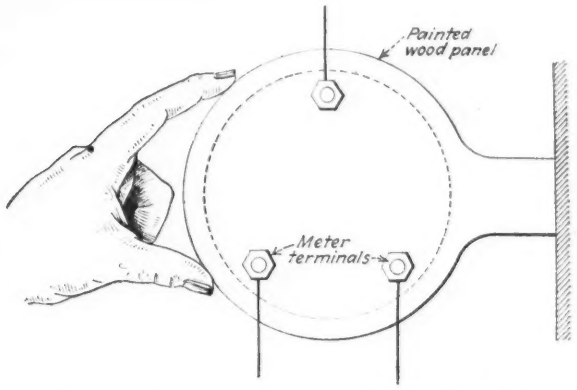
This plant has been running eighteen months now, and looks as though it was on rock. We have room for a second unit on the mattress, which we are expecting the order for at any time. With few exceptions I believe a mat is better and cheaper than piling, especially in an isolated position where a pile driver is difficult to obtain.

Toronto, Ont. G. H. HOYLES.

## Paint Causes Error In Frequency-Meter Readings

ON OUR SWITCHBOARD there is a frequency meter that could not be made to give a correct reading. The meter was sent to the factory for checking, but when it was returned and installed its readings were still incorrect. The meter is mounted on a small hard-wood panel painted black. One day one of the men happened to place his fingers on the wood as indicated in the figure and received quite a shock. Touching the wood on the meter with one finger did not cause a shock; therefore it was decided that a potential difference existed across the wood.

We found that the paint was a high-resistance conductor and when the meter studs came in contact with it there was sufficient current leakage to cause an error in the meter's readings. The meter was taken off the panel and remounted with its terminals insulated from the paint by fiber bushing. When this was done it indicated the frequency correctly and has given no further trouble.




When the wood was touched with the fingers a shock was felt

Carlsbad, N. M. E. A. ROBERTS.

## High Pressure for Ice Can Water Agitation

IN THE high-pressure air-agitation system of the modern ice plant the air is first compressed to around 35 lb. per square inch gage. It is then sent through a dehumidifier, after which its pressure is reduced, usually to about one half of the original. Under this pressure it goes on to the cans.

There is a definite purpose in first compressing this air to the higher pressure before it passes through the dehumidifier. The purpose of the dehumidifier is to cool the air and remove the moisture from it in order that this moisture will not freeze in the small air fittings on the cans and stop the air flow, causing white ice.

With a given temperature in the dehumidifier, an increased pressure on the air means that more of the moisture is removed per pound. Increasing the air pressure increases the dew point temperature of the water vapor mixed with the air. Naturally, with a given low temperature the higher the pressure, and therefore the dew point tends to rise the more of the vapor will be condensed. It is for this reason that the air is raised to this higher initial pressure before being sent through the dehumidifier.

This particular fact was brought home forcefully in my experience as an operator of a plant employing high-pressure can water agitation. Interested in bringing about savings, the idea was conceived of lowering this initial compressor pressure in order to save on the power of compression. Accordingly, this pressure was reduced from 35 lb. per square inch to slightly less than 25 lb. per square inch. The same can pressure of 15 lb. was maintained by changing the adjustment of the reducing valve.

Coming on duty to take the evening watch, I was told of this change in the operation and gave it little concern. However, when on an inspection about four hours later I noticed agitation slowing down on a great number of the cans I gave the matter more serious thought.

With the reduced pressure on the air compressor, the moisture was not being sufficiently removed from the air and was freezing in the can fittings. Accordingly, I increased this pressure to 35 lb. again and prevented a continuation of this freezing.

The "saving" of the power of compression was lost, but the ice did not freeze white. Needless to say, no one attempted to make this saving again.

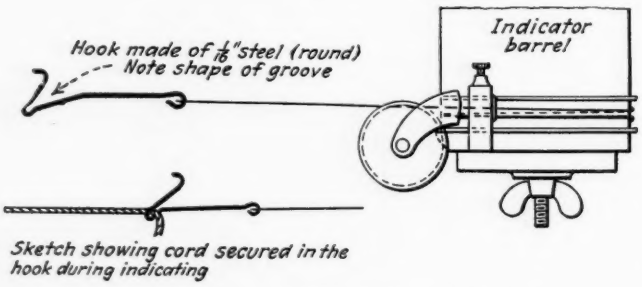
Beaumont, Texas. R. F. SORRELLS.

▼ ▼ ▼

# CURRENT COMMENT

## Simplifying the Taking of Indicator Diagrams

SOME MONTHS ago a type of spring clip designed to simplify the work of taking diagrams was illustrated and described in *Power*, but the clip appears suitable only for slow-speed engines and hardly adaptable to general use. Experience shows that any but the lightest form of clip or hook interferes with the smooth working of the cord, due to weight alone, affecting the shape of the diagram taken. It would also appear that excessive time loss


Hook made of 1/16" steel (round)
Note shape of groove
Indicator barrel
Sketch showing cord secured in the hook during indicating

**Type of hook permitting ready adjustment**

would occur when indicating several different cylinders, because of the necessary adjustments in the lengths of the cord; consequently the attachment hardly suggests simplicity or is likely to become a necessity.

As stated, indicating steam engines is not so simple a process as is generally considered. The cord attachment is one of the most important items, and of necessity this must be strong, light and easily adjustable when in use. Many types of attachments have been employed in the past to fulfill these conditions, but none seems to supersede the simple hook, which when properly shaped, and in capable hands, performs all the necessary operations successfully. Care must be taken when bending the hook to shape that the bottom is in the form of a groove similar to that used in the sheave of a rope drive, and when in actual use the cord should set lightly in the bottom of the groove.

With a hook so shaped the advantages obtained are: Easy manipulation; no interference with smooth running of the cord; cord secured without the use of knots or loops; slips when excessively loaded; adjustable in use; and takes any size of cords. J. CASSIDY.

Blackburn, England.

## Boiler Gage Glass Readings Are Misleading

THE ARTICLE by Grant Campbell on "Boiler Gage Glass Readings Are Misleading," in the Dec. 29, 1931, number is of value in pointing out a possible solution of a serious problem that is being encountered by many operators of boilers. However, it is believed that amplification of certain points may be desirable.

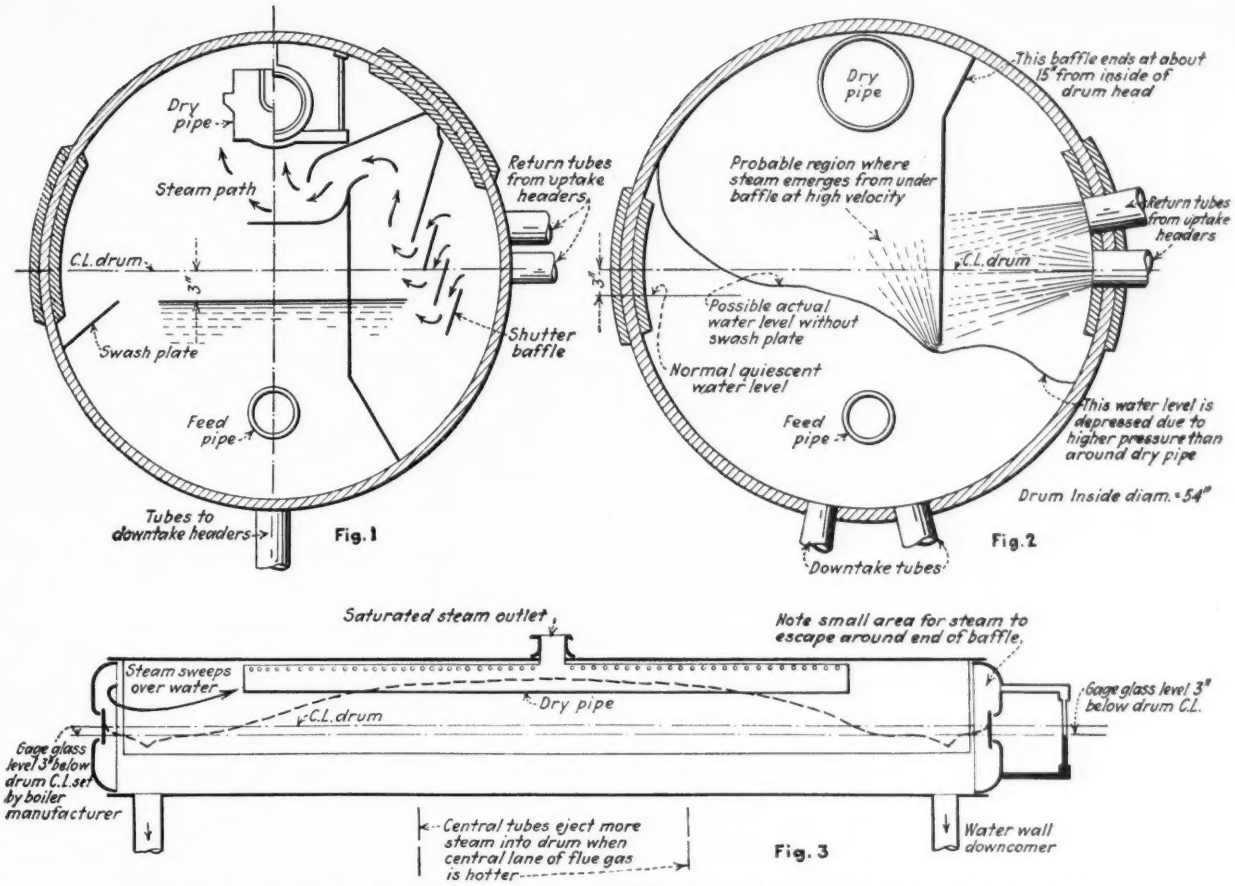
The article states that "the usual plan is to hold the level in the glass at a point where the level in the drum will be as nearly as possible at the greatest disengaging surface." The drums of many modern boilers really have no disengaging surface, properly speaking, as may be seen in Fig. 1. (See also pp. 14 and 21, N.E.L.A. Treatment of Feed Water Report, June, 1930.) The water-steam mixture enters the drum from the double row of tubes at and above the drum centerline, passes through the baffle which tends to throw the heavier water particles downward and to permit the lighter steam to pass to the dry pipe. No steam enters the drum from the downtake nipples or any source that would cause steam bubbles to form in the water in the drum and break through the water surface.

Of course, this is a modern type, but even the older type of baffle does not utilize more than a small fraction of the disengaging surface provided, as may be seen in Fig. 2. It is not believed that the steam merely bubbles through the water surface, but is ejected from under and around the baffle at a high velocity. With this type, a portion of the steam passes longitudinally along the baffle and around the end, where it enters the steam space above the drum water level; a portion goes underneath the baffle as shown, but does not utilize all the disengaging surface provided.

In the bent-tube (multi-drum) type of boiler, the larger portion of the steam reaches the outlet by way of the steam-circulating tubes. Under normal conditions no steam will bubble up through the water in the steam drums.

One of the main objects in holding the drum water level just below the drum centerline is to provide the maximum possible water storage between that point and the point where the water disappears from the gage glass; an attempt should always be made to have as little steam as possible break through the water surface.

An important object of water-level regulation is to keep the level down to a point where the water will not tend to enter the saturated-steam outlet in prohibitive quantities. To do this one must know with a fair degree of accuracy the relation between the water level in the drum and in the gage glass. Fig. 3 shows how the drum level may be higher at the center of the drum owing to water-wall connections at the extreme ends of the drum. This condition may be aggravated by a hotter lane of flue gas at the center than at the sides, because of air infiltration, furnace setting radiation, or the use of center burners with side burners cut out, or any furnace condi-


Dry pipe
Steam path
C.L. drum
Swash plate
Feed pipe
Tubes to downtake headers
Return tubes from uptake headers
Shutter baffle
Fig. 1
This baffle ends at about 15" from inside of drum head
Dry pipe
Probable region where steam emerges from under baffle at high velocity
Return tubes from uptake headers
C.L. drum
3"
Possible actual water level without swash plate
Normal quiescent water level
Feed pipe
This water level is depressed due to higher pressure than around dry pipe
Drum Inside diam. = 54"
Fig. 2
Downtake tubes
Saturated steam outlet
Note small area for steam to escape around end of baffle
Steam sweeps over water
Dry pipe
C.L. drum
Gage glass level 3" below drum C.L.
Gage glass level 3" below drum C.L. set by boiler manufacturer
Central tubes eject more steam into drum when central lane of flue gas is hotter
Water wall downcomer
Fig. 3

**CROSS SECTION OF BOILER DRUMS, INDICATING PROBABLE WATER LEVELS UNDER CERTAIN OPERATING CONDITIONS**

Fig. 1—Shutter-type baffle in drum of cross-drum boiler. Fig. 2—Old-type baffle in drum of cross-drum boiler. Fig. 3—Heaping of water toward center of drum due to (1) water wall downcomer connections, (2) hot central gas lane and cool side lanes.

tion where the fuel bed is hotter in the center than at the sides.

Another cause that tends to result in the same effect is improper dry-pipe design, so that approximately equal quantities of steam are not removed from the several portions of the drum. The worst case would perhaps be the omission of the dry pipe, so that an appreciable pressure drop would result between the ends of the drum and steam outlet, which is usually at the center. The pressure drop through the dry pipe is frequently around 3 lb. This is equivalent to a head of water of about 96 in. when the water temperature is 450 deg. F. Thus a pressure difference of only 1 lb. should be sufficient to cause a level difference of 32 in.

The statement was made that "regulation should be aimed at a limited area directly under the dry pipe, or the outlet nozzle of the boiler drum." Because in the majority of cases the dry pipe extends for nearly the full length of the drum, such regulation might prove difficult to attain. However, it may be probable that, by using several of the elements described in Mr. Campbell's article, the elements recording the highest water level may possibly be used to regulate the feed-water supply, thus preventing the water level from rising above a point that would cause excessive carryover.

Although it is possible that the element would not cause a lowering of the level in the water column if connected to it and if used as part of a continuous blowdown system, it must be remembered that modern practice is to keep the water column free of all such connections. Even the modern feed-water regulators, requiring little or no flow, are now always provided with their own separate connections to the drum, as they were found to cause trouble if connected to the water column.

It would indeed be a great advance if the apparatus described could be used to obtain the different levels existing in a boiler, and, further, if the indications obtained could be used as a means of controlling the feed-water supply accordingly. However, caution would be necessary in providing the proper relation between the size of the perforation in the sampling pipe and the size of the expansion orifice. If the drum pressure were 400 lb. and the pressure in the expansion chamber around 30 lb., the pressure on the drum side of the orifice would only have to be 399 lb. to have the water rise 32 in., or just about up to the orifice, flooding it.

Another difficulty would result from the modern practice of maintaining constant pressure at the superheater outlet, letting the drum pressure variation allow for changes in the superheater pressure drop. This latter may be as high as 30 lb. It is possible that a calibration curve could be drawn up showing the relation between element pressures and water level in the sampling pipe for various drum pressures. This would entail some experimentation. An explanation of the physics of the phenomena causing the pressure in the expansion element to vary as the water level in the sampling tube, thus producing the curve shown in Fig. 3 of Mr. Campbell's article, would be of great assistance in the solution of this problem.

E. H. KRIEG,
Mechanical Design Dept.,
Electric Bond & Share Co.
New York City.

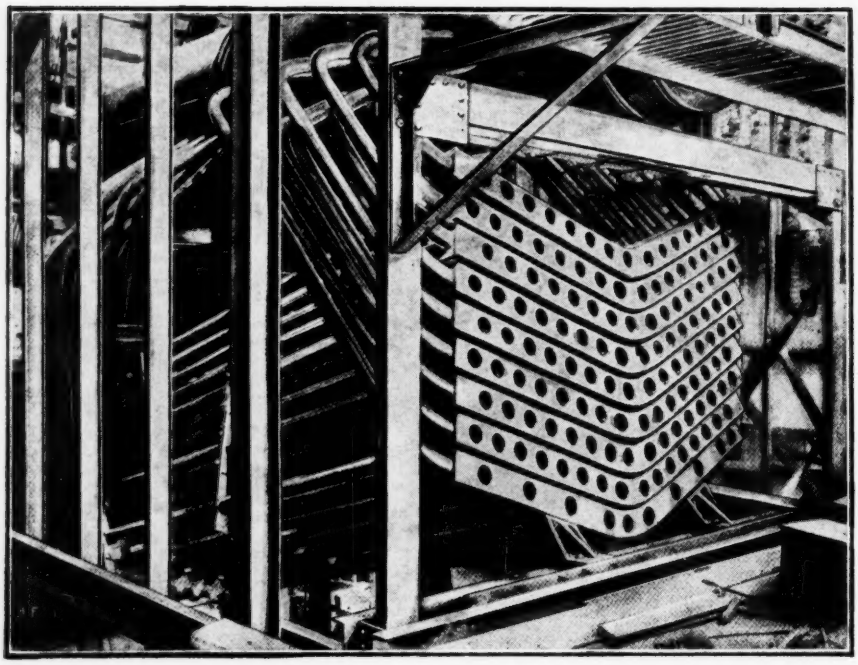


Fig. 1—General view of boiler assembled

# Novel Tube Arrangement Used in Belgian Boiler

A BOILER design very different from those familiar to American engineers is shown in the accompanying illustrations. These were taken from the A.F.S. *Journal*, edited by the "Societe Anonyme des Chandronneries A. F. Smulders, à Grace-Berleur lez-Liege" of Belgium.

The tube arrangement of this type boiler (Jiges patents) will be clear from the illustrations.

To promote intensive circulation the headers are square in section and hot-pressed in the form of a V, each leg of which forms an angle of 20 or 25 deg. with the horizontal. The heating surface is thus made up of independent sections, each in the form of an open V. These are stacked vertically one above the other. The tubes are inclined at 25 deg. or more to the horizontal. The boiler drums may be placed either parallel or perpendicular to the tubes.

At both ends of each header connecting tubes run to the upper drum. Thus each section receives water from two connecting tubes and delivers water and steam by two more.

To utilize uniformly all the evaporating surface, the communicating tubes enter the drum at points distributed along its length.

In the A.S.F. boiler all the tubes of the same section are in a zone of approximately the same temperature. This tends to equalize expansion. Sections close to the fire have fewer tubes, permitting the effect of radiation to extend for several sections.

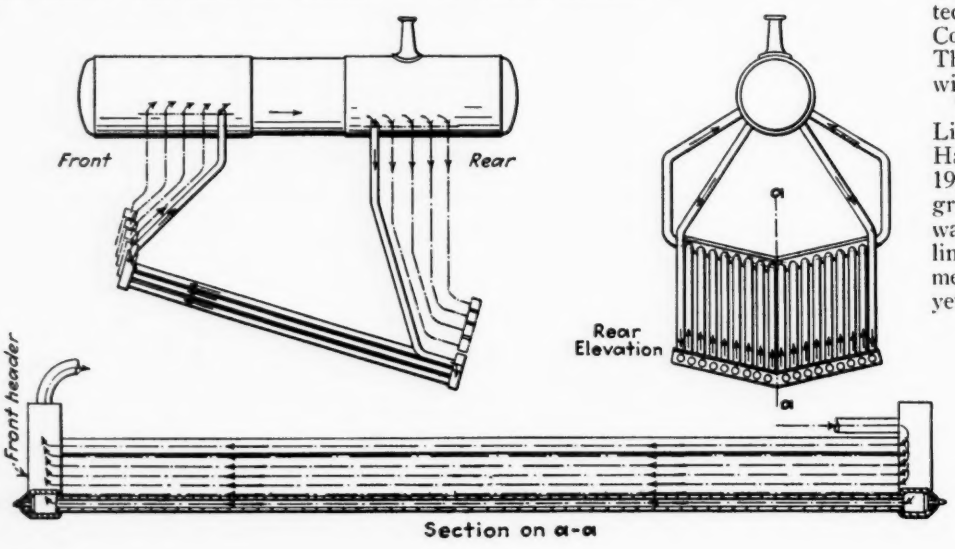



Fig. 2—Sketch showing construction and arrangement of a single section

## International Congress of Mechanical Engineering

AFTER SEVERAL YEARS of inactivity following the World War, the International Congress of Mechanical Engineering is again being organized to play a definite part in mechanical engineering affairs.

This organization originally came into being in 1905 at the second session of the International Congress of Mining and Metallurgy and Practical Geology, held in Liége, France. It was combined with the latter under the name of International Congress of Mining and Metallurgy and Applied Mechanics, and the proposal was made that subsequent meetings be held every five years.

Accordingly a meeting was held in 1910 at Dusseldorf, Germany, where it was decided that each country should nominate a permanent committee to carry on the work of the congress during the five-year intervals between plenary meetings. Plans were made to hold the next session at London in the summer of 1915.

With the advent of the World War, however, the 1915 meeting was not held and the organization was not revived until 1928, when plenary and sectional meetings of the World Power Conference already had been held, as well as sessions of the International Congress of Applied Mechanics. In order not to conflict with these bodies it was decided to limit the field of the organization to problems of practical design relating to the construction and operation of mechanical plants. These include prime movers, locomotives, power-driven machinery, steam generators, power transmission, mechanical measuring and recording instruments.

Under the title "International Congress of General Mechanics," a meeting was held at Liége in 1930, at which a committee was appointed to go into the subject of future sessions. The name "International Congress of Mechanical Engineering" was adopted at the 1930 meeting, and the idea was advanced for an all-embracing international organization to include the World Power Conference, International Electrotechnical Commission, International Congress of Applied Mechanics, etc. This idea, however, did not meet with favor.

The committee appointed at the Liége session reported at The Hague, Holland, in September, 1931, and the International Congress of Mechanical Engineering was officially organized along the lines already mentioned. Announcement of future meetings has not as yet been made.

# Amended Engineers' License Law Takes Effect in New York State

SEVERAL IMPORTANT amendments to the New York State Education Law covering the licensing of professional enginers, architects and land surveyors, became effective on March 29, when they were approved by Governor Roosevelt. By more specific definitions, these amendments help to eliminate certain misunderstandings as to the practice of engineering and architecture, and they clarify and elaborate the regulations governing educational requirements for license, exemptions and what constitutes unlawful practice.

The new law recognizes that the professions of engineering and architecture do overlap. It includes the term "building" in the definition of engineering and requires applicants for engineers' licenses to establish by written examination their competency "to plan, structurally design and supervise the construction of buildings and similar structures." That members of either profession may practice in the undefined common zone is further recognized by "saving clauses" in each section exempting licensees of the other profession. In substance, both professions are placed on an equal basis before a client, corporation, municipality or the state. Either the architect or the engineer may accept a commission as a principal and retain the services of the other on any project covered by the definitions set forth in the respective sections of the law.

### Professional Engineering and Architecture Defined

According to Section 1449, "a person practices professional engineering, within the meaning and intent of this article, who holds himself out as able to perform or who does perform any professional service, such as consultation, investigation, evaluation, planning, design, or responsible supervision of construction or operation, in connection with any public or private utilities, structures, buildings, machines, equipment, processes, works, or projects, wherein the safeguarding of life, health or property is concerned or involved, when such professional service requires the application of engineering principles and data."

The practice of architecture is defined in the amended law as follows: "A person practices architecture, within the meaning and intent of this article, who holds himself out as able to perform or who does perform any professional service such as consultation, investigation, evaluation, planning, design, including aesthetic and structural design, or responsible supervision of construction, in connection with any private or public buildings, structures or projects, or the equipment or utilities thereof, or the accessories thereto, wherein the safeguarding of life, health or property is concerned or involved, when such professional service requires the application of the art and science of construction based upon the principles of mathematics, aesthetics and the physical sciences."

### Requirements for License

Amendments made to the law in 1931 set up specific educational requirements and made examinations obligatory after 1937 for all except "applicants who are possessed of long-established and recognized standing in the engineering profession." This exemption is retained in the law, but other exemption provisions and the provisions relating to applicants subsequent to 1937 have been altered to read:

"Upon the recommendation of the board the department may exempt from examination an applicant for license as professional engineer who holds a license or certificate to practice professional engineering issued to him upon examination by a legally constituted board of examiners in any other state or political subdivision of the United States, or who holds a certificate of qualification issued by the national council of state boards of engineering examiners, provided the requirement for such license or certificate was the full equivalent of the requirement in this state at the time it was issued, and provided, further, that the applicant's record fully met the requirement of this state in all respects other than examination.

"Every person applying subsequent to Jan. 1, 1937, for a license as professional engineer shall be required to pass the examination, and before admission thereto shall submit evidence that he has graduated from a college or school for engineering registered by the department as maintaining satisfactory standards. He shall also submit before admission to the examination evidence of practical experience in professional engineering work of a grade and character satisfactory to the board. Each complete year of study in the registered college or school of engineering may be accepted in lieu of one year of such experience and the applicant must submit evidence of sufficient additional experience to give him a total of eight years. In lieu of such graduation, an applicant may be admitted to the examination upon presenting evidence of at least twelve years of practical experience in professional engineering work of a grade and character satisfactory to the board."

To the list of exemptions from the provisions of the engineers' license law as it stood at the time of revision, the following has been added: "Any person licensed as an architect under the laws of this state, except that such person shall not use the designation engineer or engineering unless licensed under the provisions of this article." A corresponding clause has been added to the architects' law.

The section exempting officers or employees of corporation engaged in interstate commerce has been expanded to include other public service organizations. It now reads:

"Practice of professional engineering or land surveying, exclusively as an officer or employee of a public service corporation by rendering to such corporation such service in connection with its lines and property which are subject to supervision with respect to the safety and security thereof by the public service commission of this state, the interstate commerce commission or other regulatory body and so long as such person is thus actually and exclusively employed and no longer."

### Unlawful Practice

What constitutes unlawful practice of professional engineering has been restated to make it more clear that holding oneself out to be a professional engineer constitutes violation of the law. The section relating to unlawful practice now reads:

"It shall be unlawful for any person to practice or to offer to practice professional engineering or land surveying in this state or to use the title professional engineer or land surveyor, or any title, sign, card or device to indicate that such person is practicing professional engineering or land surveying, or is a professional engineer or land surveyor, unless such person has been duly licensed under the provisions of this article."

### State Work Demands License

The same section also has been expanded by addition of the following:

"No official of this state, or of any city, town or village therein, now or hereafter charged with the enforcement of laws, ordinances or regulations relating to the construction or alteration of buildings or structures, shall accept or approve any plans or specifications that are not stamped with the seal of a licensed architect or licensed professional engineer."

Changes in the sections of the law relating to architects provide for licensing of architects (instead of registering as at present) so that members of both professions now are licensed. Hereafter the licenses of members of both professions are required to be registered annually instead of renewed. This change preserves the use of the term "registered architect" and makes it possible for engineers who object to the use of the term "licensed" to use the term "registered professional engineer."

# READERS' PROBLEMS

STOP VALVES ON WATER COLUMN—*Our chief engineer claims it is against the law to put stop valves on water column connections. A government boiler inspector says "No." Who is right?* G.S.

The answer to your question depends upon the state, as each state has its own boiler laws. However, many states have adopted the Boiler Code of the American Society of Mechanical Engineers. This permits the use of shut-offs, but under certain restrictions. These are given as follows in Par. 293 on page 79 of the 1930 edition of the code:

"When shut-offs are used on the connections to a water column they shall be either outside-screw-and-yoke type gate valves, or stop cocks with levers permanently fastened thereto and marked in line with their passage, or of such other through-blow construction as to prevent stoppage by deposits of sediment, and to indicate by the position of the operating mechanism whether it is in the open or closed position, and such valves or cocks shall be locked or sealed open. Where stop cocks are used, they shall be of a type with the plugs held in place by a guard or gland."

FLOW THROUGH NOZZLE.—*How much steam will pass through a converging nozzle having an opening of $\frac{5}{64}$ in., the applied pressure being 180 lb. gage and the discharge atmospheric?* S.L.W.

There are several formulas, the simplest being "Napier's Rule":

*Flow in pounds per second = Area in square inches × Initial pressure in pounds sq.in. abs. ÷ 70.*

Here the hole diameter is $\frac{5}{64}$ = 0.078 in. and the area $(.078)^2 \times 0.785$ = 0.00477 sq.in.

Then *flow* = 0.00477 × 195 ÷ 70 = 0.0133 lb. per second.

This equals 0.0133 × 3,600 = 48 lb. per hour.

"Napier's Rule" is only approximate. The exhaust pressure has nothing to do with the flow as long as it is less than 57 per cent of the initial pressure, both being expressed in absolute terms.

HEAT FROM ENGINE EXHAUST—*We are planning to attach a waste-heat boiler to the exhaust of our oil engine. In calculating the amount of heat possible to recover may one use the pyrometer reading as the average temperature of the exhaust?* T. T.

A pyrometer may not register the actual exhaust temperature, due to formation of carbon on the element and to radiation to the exhaust pipe. For accurate readings a thermocouple should be used. But for practical purposes a pyrometer properly placed will yield satisfactory results. However, the heat in the exhaust cannot be found accurately by taking the average temperature. This is due to the fact that when the exhaust port or valve opens, the cylinder gases rush out at a high temperature and high velocity, both of which drop as the pressure decreases. The result is that the heat calculated from the average temperature is too low. According to L. R. Underwood, who reports the results of a series of tests in *Engineering*, (London), the actual heat is 124 per cent of that calculated from the average temperature in case of a single-cylinder engine, 112 per cent with a two-cylinder unit, 104 per cent with a four-cylinder and 102 per cent with a six-cylinder engine.

▼ ▼ ▼

# Does It Pay To Compress Steam?

## Some Readers say "Yes," others "No" for conditions outlined by J. F. M. in March 22 issue

*EXHAUST STEAM is delivered to all parts of our factory at 10 lb. gage pressure for heating and process. All steam is generated at 150 lb. pressure. A reducing valve from 150 lb. to 10 lb. is installed but rarely in operation, because the 10-lb. exhaust generally exceeds the requirements. Some of the 150-lb. steam is piped to one department and there reduced to 50 lb. for special process work requiring that pressure. It has been proposed that we save a certain amount of the 150-lb. steam by taking the 10-lb. steam available in this department and there boosting its pressure to 50 lb. The total amount of 50-lb. steam required averages about 2,500 lb. per hour during the working day, with a peak load slightly higher.*

*How much advantage would there be in saving high-pressure steam in this way? In what ways could the boosting be accomplished? Which is the most practicable from the point of view of cost, ease of operation and reliability?* J.F.M.

### It Won't Pay

WHILE IT IS entirely possible to compress steam from 10-lb. gage pressure to 50 lb., considerable power is necessary and it is rather questionable whether in this particular case it would pay.

To compress one pound of steam from 10 lb. gage to 50 lb. adiabatically would require about 80 B.t.u. If 10 B.t.u. is added to compensate for heat losses and friction, the actual expenditure would be 90 B.t.u. It is reasonable to suppose that the source of power is a steam unit having steam supplied to it at 150 lb. gage and exhausting at 10 lb. gage. The work obtainable from each pound under these conditions is about 141 B.t.u. on the basis of the Rankine cycle.

Not more than 60 per cent of the work of the Rankine cycle can be made available to the compressor. This would be about 85 B.t.u., or only slightly more than the adiabatic work necessary to compress the steam, and certainly less than the actual work required.

Evidently, then, it would not pay on a B.t.u. basis. Furthermore, when the cost of compressing equipment and extra power-producing capacity (to the extent of about 80 hp.) are considered, it becomes still more clear that the proposed plan would be a losing proposition financially. A far better plan, if a turbine unit is used as the prime mover, would be to bleed the turbine at an intermediate stage. WALLACE MARTIN.

Corvallis, Wash.

### It Will!

A SAVING of 400 lb. per hour of steam could be effected by the installation of a steam-jet thermocompressor. This machine would draw in the 10-lb. pressure steam by means of the velocity energy created by expanding 150 lb. steam through a properly designed orifice, and would recompress the mixture to 50 lb. gage pressure.

The installation cost of the thermocompressor, complete with hydraulically operated discharge pressure and quantity-control unit, would be not over $500. An allowance of $50 for the reducing valve removed to make place for the thermocompressor would bring the total cost down to $450. A value of $1 for the steam saved per 8-hr. working day would be well under the average industrial power plant steam cost and would mean a saving of over $300 a year. This would appear to justify the installation.

Since the thermocompressor would be entirely automatic, there should be no operating cost. Furthermore, since

the thermocompressor itself has no moving parts, it would be extremely reliable. It could be operated continuously even if the hydraulic regulator got out of order. K. K. FISCHER.

Philadelphia, Pa.

## Simple Pump Rig

REMOVE the 150-50 lb. reducing valve or keep it as stand-by. Leave the 150-10 lb. reducing valve. Install a duplex or a flywheel pump with pump cylinders equipped with steam packing rings and with proper ratio of cylinders delivering to the 50-lb. line and taking steam from the 150-lb. line. This should be properly piped to avoid trapped condensate and governed to maintain 50 lb. on the 50-lb. line with a diaphragm governor. Add a speed limit governor if a flywheel pump is used.

The power cylinders of this pump should have the exhaust connected directly to the suction side of the pump or the 10-lb. line. Aside from the small radiation loss and maintenance and capital cost the operation of this unit should cost nothing. E. E. CLOCK.

Passaic, N. J.

## Use Small Turbine

MORE DATA would have to be had before any definite recommendation could be made. Considering the problem generally, it would seem that the oversupply of 10-lb. exhaust steam could be best prevented through the bleeding of the main power turbine, if this could be arranged for, thus lessening the amount of exhaust. The loss of developed energy through incomplete expansion of the bled steam is less than that which would have to be expended in recompressing it from exhaust pressure back to the bled pressure, everything considered.

If engines are used for power generation, or it is not practicable to bleed the turbines now used, then a small turbine- or engine-driven electric generator could be used to furnish the 50-lb. process steam. The unit would operate with a 50-lb. back pressure, load control from the pressure in the process line or 10-lb. line, delivering current to the main power circuit. This would cut down the amount of 10-lb. exhaust from the main units.

A steam-driven compressor could be used, the power cylinder to exhaust at 50 lb. and the compression to be from 10 lb. to 50 lb. This would supply the process steam partly through exhaust from the power cylinder and partly through boosting steam from the exhaust lines of the main power units. The boosted steam would require somewhat more power than it would yield through its expansion in the main power units.

A motor-driven compressor might be used to boost the exhaust pressure, but the energy developed by the steam in falling from 50 to 10 lb. would not nearly supply that required for its compression back to 50 lb., when account is taken of the compressor-motor-generator-engine efficiency. Also, the compressor required would be larger than that if steam-driven as outlined above.

Although the bled turbine and separate small generating unit appear to be the most efficient methods to prevent excess 10-lb. exhaust, from a control standpoint the compressors might possess some advantage. M. W. DAVIDSON.

Vermillion, S. D.

## Cost Analysis

SEVERAL PLANTS in this country have installed compressors in order to utilize an available supply of low-pressure steam and at the same time obtain steam under a higher pressure for special work. An installation I know of consists of motor-driven reciprocating compressors which have been operated satisfactorily with small maintenance costs.

Centrifugal and reciprocating compressors are the most practical methods of compressing steam, although the reciprocating method is preferable. Centrifugal compressors usually require a large number of stages and unusually high speeds, which are objectionable.

To calculate the cost of installing and operating a motor-driven reciprocating compressor large enough to handle the requirements stated in the question, it will be necessary to make certain assumptions that may be changed to suit the actual conditions. In this anser it is assumed that electricity is charged at a rate of 1.5c. per kilowatt-hour and that the 50-lb. steam costs 80c. per 1,000 pounds.

Data from an actual installation of a reciprocating compressor used to compress steam from a pressure of 35 lb. to 80 lb. showed a power consumption of 40 kw.-hr. per 1,000 lb. of steam and a calculated over-all efficiency of the unit of 38.8 per cent.

Cost of compressing steam under conditions stated is, then, computed as follows:

| | | |
|---|---|---|
| Total heat after adiabatic compression from 10 lb. dry and saturated to 50 lb., B.t.u. per lb. | | 1,241.0 |
| Total heat at 10 lb. dry and saturated, B.t.u. per lb. | | 1,160.0 |
| Theoretical increase in heat during compression, B.t.u. per lb. | | 81.0 |
| Power consumed in compressing 1,000 lb. of steam $= \frac{81 \times 1,000}{3,415 \times 0.388}$, kw.-hr. | | 61.1 |
| Power consumption per year (based on 2,500 lb. of steam per hour, 8 hr. a day, and 310 days a year) $= \frac{2,500 \times 8 \times 310}{1,000} \times 61.1$ kw.-hr. | | 379,000 |
| Cost of electricity per year at 1.5c. per kw.-hr. | | $5,685 |
| Cost of compressor, motor and auxiliaries | $8,000 | |
| Cost of unloading, hauling and foundation | 2,000 | |
| Total investment | $10,000 | |
| Yearly charge for interest, depreciation, taxes, etc. ($10,000 × 15 per cent) | | 1,500 |
| Yearly cost of compressing steam at rate of 2,500 lb. of steam per hour from 10 lb. to 50 lb. pressure | | $7,185 |
| Yearly value of 150-lb. steam which will be saved by compression of 10-lb. steam $\frac{2,500 \times 8 \times 310}{1,000} \times 0.80$ | | 4,960 |
| Additional yearly cost of compressing 10-lb. steam rather than using 150-lb. steam through reducing valve to obtain steam at 50 lb. pressure | | $2,225 |

It is stated in the question that there is usually an excess of 10-lb. steam, but it is not stated whether or not some of this low-pressure steam is wasted. If it is the case that the heat in all the excess 10-lb. steam is reclaimed, the above value of $2,225 is the difference in cost for the assumptions made, but if some of the 10-lb. steam is wasted, then the difference should be reduced by the value of the wasted steam.

Based on the assumptions used in this answer, no advantage is obtained in utilizing the excess 10-lb. steam by compression. E. L. NINGARD.

Baltimore, Md.

## A Question for Our Readers

*I HAVE a 350-hp. Stirling-type boiler served by an underfeed stoker four retorts wide. The load on the boiler is seldom over 100 per cent of rating and most of the time between 35 and 50 per cent. What, if any, will be the effect on the water circulation within the boiler when one of the outside retorts is blanked off, the boiler being served by the remaining three retorts? Would any fuel be saved? About how much would be saved? The boiler is in service 24 hr. per day and generates steam at 180 lb. gage, no superheat. Feed water is about 85 per cent returned condensate and 15 per cent of raw make-up. Coal used is Wyoming slack.*

S. L. W.

Suitable answers from readers if received promptly, will be paid for when published. Typewritten replies should proferably be double spaced.

## Watch the Temperature

MANY FIRMS overlook the matter of temperatures for their manufacturing—many times going to excessive pressures, which are detrimental and costly to the power plant. The best process, dry heating or inclosed heating, uses a return and a vacuum of at least 24 in., fast operating traps, and automatic input control with recording thermometer to hold constant conditions.

Where temperature ranges of over 200 deg. F. are necessary, and with steam at 50 lb. pressure, a separate return system should be used, and it is far better to reduce from boiler pressure with a reducing valve than to attempt a costly investment for boosting pressure.

My advice to J.F.M. in solving this problem is to strike a heat-balance cost on the utilization of exhaust and live steam. L. A. CORWIN.

Milwaukee, Wis.

# WHAT'S NEW IN PLANT EQUIPMENT

## Guide-Rail Lubricator Uses Stick Greaser

LUBRICATION of the guide rails is the most difficult problem connected with passenger and freight elevators. The lubricated surfaces of the rails are exposed to the atmosphere of the hoistway, to collect dust and dirt that may be blown about by the car as it passes up and down the hoistway. In modern high buildings the rails may be several hundred feet long. The length of the rails adds materially to the difficulties of the problem of maintaining a good film of lubricant along their entire length.

If the oil film becomes too thin or broken the guide shoes will begin to bite the rails, causing noisy and unpleasant riding of the car, increased wear on the guide shoes and increased power consumption. When there is an excess of lubricant on the rails it is thrown off by the guide shoes onto the car and into the bottom of the hoistway. If oil gets onto the car it is likely to work into the inside of the cab and cause stains, or worse, get onto passengers' clothing. In addition, it creates a dirty condition in the hoistway and adds to the difficulties of keeping the place clean.

To meet the exacting requirements of a guide-rail lubricator in modern elevator service the Bowman Agency, Inc., Arlington, N. J., has brought out a new type of grease lubricator, Figs. 1 and 2, that is mounted directly on the guide shoes and is known as the B-B Lubricator. In this lubricator a special high-grade grease in stick form is used. The grease stick *G* is put in the barrel *B* and is forced out onto the rail by the metal block *M*, which is pushed ahead by the feed screw *F*. The grease is applied to the rail by the fiber riding shoe *R*. This shoe is supported in a carrier that is pivoted at *P*, so that no strain is placed on the lubricator if the car has side motion due to worn guide shoes or other causes.

On one end of the feed screw is a ratchet wheel *W*, which is turned by the ratchet *T*, operated through shaft *S*, on which is mounted the operating lever *L*. A small cam is mounted at the top or bottom end of the guide rail and as the car approaches the end of travel it comes in contact with operating lever *L* and moves the ratchet wheel and feed screw to supply a small amount of lubricant to the guide rail.

The amount of grease fed to the guide rail is controlled by the adjusting screw *A*. Normally the feed is adjusted to move the ratchet wheel one notch for each trip of the car. At this rate of feed a 6-in. grease cartridge is sufficient to lubricate the rail for 24,000 round trips. Higher rates of feed can be obtained by increasing the throw of the ratchet. On cars running in very long hoistways a cam is placed near the top and the bottom of the guide rails so that grease is fed to the rails at both ends of car travel.

When the lubricator is to be filled the feed block *M* can be released from the feed screw by pulling down on trigger *D*, after which the block can be moved back to the full position. The grease barrel is sealed against dirt by the cover *E*, which is held tightly in place without the use of screws.

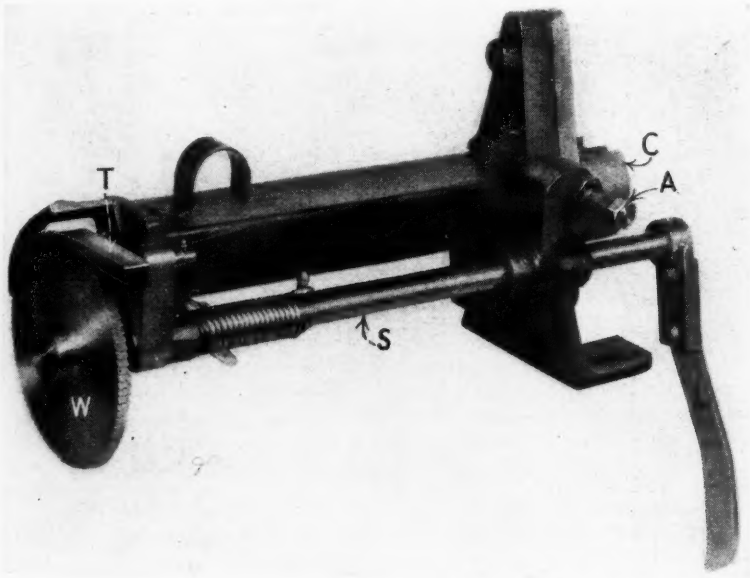



**Fig. 2 — Lubricator completely assembled ready for mounting on the guide shoes**

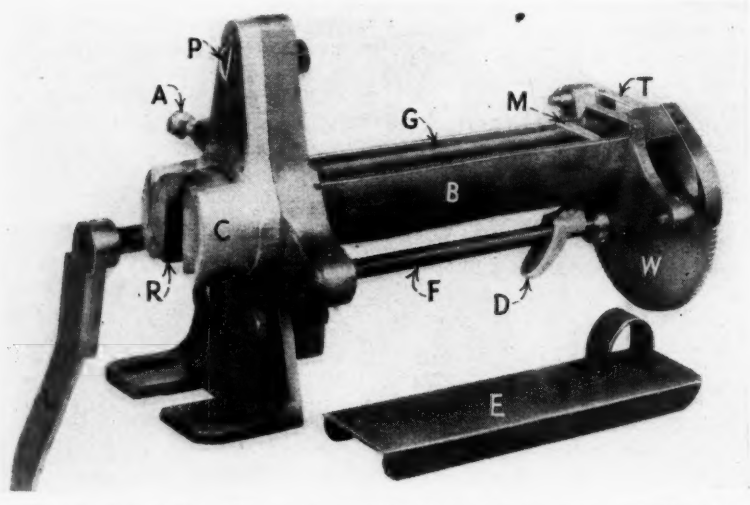



**Fig. 1—Lubricator with cover removed to show the grease cartridge G**

## Solder for Wide Range of Metals

ALUMAWELD is the name given to a new solder which it is claimed can be used to repair cast iron, steel, aluminum, pot metal, die castings, brass and bronze. In using the solder the broken part is cleaned and then heated with an ordinary soldering iron, then the solder with special flux is applied. Although much harder than ordinary solder, the new solder is said to machine easily, to be ductile, and to take a good polish. It will withstand pressure up to 1,000 lb. hydrostatic and up to 500 lb. steam pressure at live steam temperature. The solder is put out by the Allied Research Laboratories, Glendale, Calif.

## Ring-Balance Flow Meters

THE RING-BALANCE flow meter illustrated, which has been used extensively in Europe, is now being introduced in this country by H. A. Bassert & Company, 310 South Michigan Ave., Chicago, Ill.

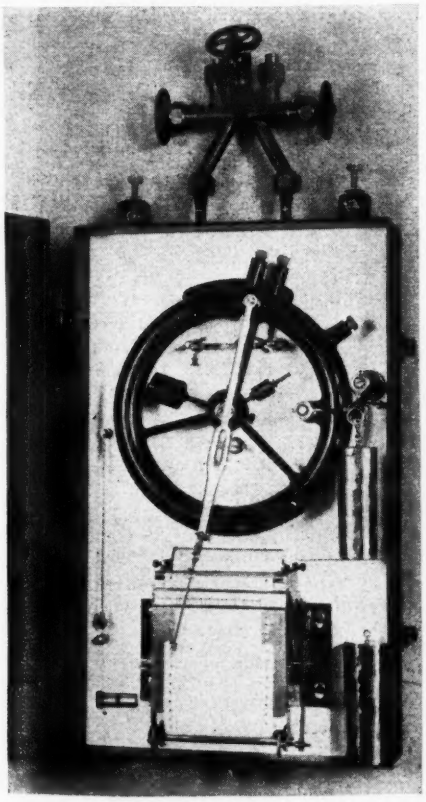
In principle, the actuating mechanism of the meter consists of a hollow seamless steel-tube ring, with a sealing partition at the top to make it a U-tube manometer in principle, filled with mercury or other fluid to a predetermined level and suspended on knife edges at its center of gravity. At the top of the ring and on either side of the dividing partition inlets are connected by flexible pipe to the upstream and downstream sides of an orifice plate, venturi or pitot tubes or nozzle located in the pipe which carries the medium to be measured.

A pressure difference at the inlet connections due to flow through the orifice plate causes a corresponding difference in level of mercury or other fluid used in the ring. This, in turn, causes the ring to rotate around its center an amount directly proportional to the difference in fluid level within the ring. The movement of the ring or of a pointer fastened to the ring is thus proportional to the square of the flow which is being measured.

The illustration of the meter with the front casing open shows the ring mechanism with connecting inlets on each side of the partition within the ring as well as the square-root extracting device and the method of transferring the movement of the ring directly to an indicating and recording penarm. The record is made on a clock-driven roll chart. In addition an electric integrator may also be attached.

The ring element is built for two different major pressure ranges, the first, of seamless steel tubing, as shown, is for the higher pressures encountered with steam or water. The second, with the ring made of sheet brass of rectangular cross-section, is for the low pressures encountered in the measurement of gas or air flow.

In the high-pressure type connection to the ring is made through elastic, loosely wound coils of capillary tubing. In the low-pressure type, connection is made through rubber tubing.



**Ring-balance meter with front cover open**

## Water Cooled by Vacuum Refrigeration

TO SUPPLY the needs of industry and of air-conditioning systems for cooling water at temperatures of 32 to 50 deg., the Foster Wheeler Corporation, 165 Broadway, New York City, has developed a vacuum refrigeration system which operates on the principle of flash evaporation.

The water to be cooled is piped into a chamber in which a high vacuum is maintained. If the temperature of the water supplied is above that corresponding to saturation temperature for the vacuum in the chamber, evaporation will occur. The vapor liberated from the body of water absorbs latent heat of vaporization from the water introduced into the flash chamber. This removal of heat cools the remaining water to a temperature corresponding to the absolute pressure in the flash chamber. Thus, for example, if the chamber is maintained at an absolute pressure of 3 in. of mercury the water may be cooled to a temperature of 45 degrees.

The illustration shows a diagram assembly of equipment developed to produce vacuum refrigeration. The thermocompressor consists, essentially, of a group of steam nozzles directed toward an entraining throat. The steam is introduced into these nozzles and in passing through them attains a high velocity, so that there is a group of high-velocity streams at the nozzle exit. The vapors which enter the suction opening of the compressor are entrained in the stream and compressed to a pressure at which the condensing temperature is above the temperature of the normal water supply.

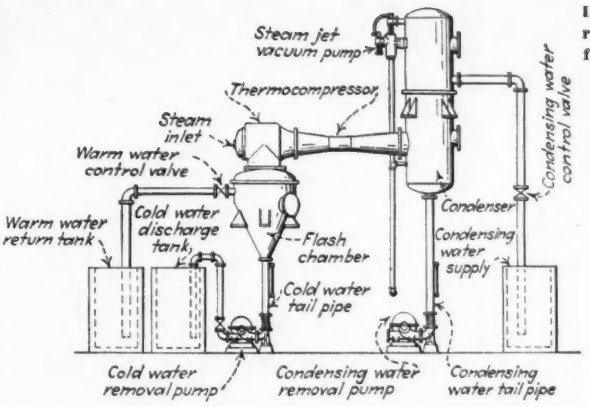
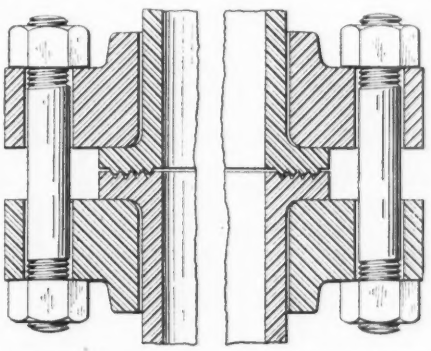


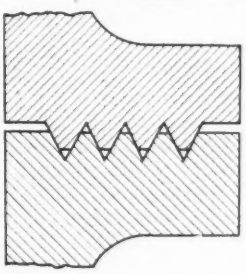

**Diagram of vacuum refrigeration system for cooling water.**

The thermocompressor discharges into a high-vacuum condenser which in turn is served by a two-stage steam jet for air removal. Two pumps are provided, one for removing the cooled water from the flash chamber and one for removing the condensing water.

## Improved Van Stone Pipe Joint

THE ABILITY to make a tight joint at the highest pressure without the use of a gasket between the flanges or welding around the outer circumference of the flanges, as is frequently done, is a feature of the improved Van Stone joint illustrated, introduced recently by the American Power Piping Corporation, 706 Security Building, St. Louis, Mo.





**Above — Assembly of American Van Stone to Van Stone connection**

**Left—Detail of joint seating surface**

Tight seating of the joint is effected by means of concentric V grooves and rings on the flanges as shown in the assembled view of the joint and in the enlarged detail. When the joint is drawn up the raised rings on one flange are pressed into the grooves in the other flange, giving a steam-tight joint suitable for use with the highest pressures and superheat. An additional feature of the joint is that it can be taken apart and put together again any number of times without affecting its ability to stay tight.

# NEWS of the FIELD

## First Three Dnieper Units in Service Soon; More Hydro and Wind-Power Plants to Be Built

INSTALLATION of the first three units of the 840,000-hp. Dnieper hydro-electric development in Soviet Russia has been completed and the first unit is now in trial operation. The turbine of the fourth unit has been set up, but due to late arrival of equipment the generator is only half completed. All four units are scheduled to go into commercial operation next month. Each turbine is rated at 84,000 hp. and is connected to a 77,500-kva. generator.

Immediate construction of three large hydro-electric plants on the Volga River has been ordered by the Council of People's Commissars of the Soviet Government. Located in Ivanovo-Voznesensk, Nijni-Novgorod and Perm, these three stations will have a total capacity of 800,000 to 1,000,000 kw. They are to be ready for operation in the spring of 1935.

A. V. Winter, American engineer who supervised erection of the Dnieper project, has been put in charge of the new construction. In the spring of 1933 the technical personnel and the construction equipment will be transferred to the new jobs where the experience gained in the construction of Dnieprostroy will be applied.

Construction of a 6,000-kw. station in Khabarovsk is to begin at once. The production of electric power in West Siberia will be increased four times. One station with a capacity of 48,000 kw. is starting in Kemerovsk, another in Novo-Sibirsk is nearing completion, and a number of substations are beginning to operate in the Kuznetzk district.

The experiment of building a wind-power station in the Karansky Mountains near Balaklava, Crimea, has proved completely successful, the council reports. Three more wind-power stations are to be built in Crimea next summer, two of which forming one unit are to be located near the experimental station in the Karansky Mountains. The power produced by these stations will be used in the regular electric system of Crimea.

A new experimental water-power station, with large storage batteries, of a capacity of 1,500 kw. is to be built on the Sukhaya River in the Balaklava region for the testing of the combined operation of wind- and hydro-power stations. This testing station is to work out a plan for the construction of a number of wind-power stations in Ai-Petri, which will produce up to 100,000 kw. of electric power. This construction plan is part of the Second Five-Year Plan.

## World Power Conference In Scandinavia Next Year

DENMARK, Sweden and Norway will participate in a sectional meeting of the World Power Conference in 1933, which will open at Copenhagen on Monday, June 26, with technical sessions at Stockholm from June 28 to July 4 inclusive and further proceedings in Norway from July 7 to the closing session at Oslo on July 10. The technical program will be devoted primarily to the power problems of "heavy" industry and of sea and land transport. Visits to plants and developments in all three countries and in Finland will be made.

This announcement is contained in the annual report of O. C. Merrill, chairman of the American Committee, World Power Conference, who also says that chemical engineering interests have expressed the desire to hold in London in 1934 or 1935 under the auspices of the World Power Conference a sectional meeting on the chemical industries, which would be financed by these interests.

## Canadian Research Council Studies Coal Classification

WITH REGARD to coal classification and analysis, elaborate plans are under way in Canada involving laboratory researches and the work of numerous subcommittees of the National Research Council of Canada. Recently Professor Edgar Stansfield, of the Dominion Department of Mines, outlined the results of the chemical survey of Alberta coals which had been carried out by the Alberta Research Council in cooperation with the Alberta and Federal Department of Mines. The samples from the mines were chosen to represent an irregular section of the province where the desired range of coals could best be obtained. The suitability of the location chosen was indicated by the fact that on a pure moist-coal basis the fixed carbon varied from 78 to 32 per cent. In no other part of Canada was such a range of coals available in so short a distance.

Much laboratory work had been done on thirteen samples of coal obtained, including proximate and ultimate analysis, separations by heavy solutions to eliminate the effect of ash, storage index, strength index, accelerated weathering tests, alkali treatment, ignition temperatures, and fusion points of ash.

During the last year six standard samples of coal have been distributed to each of a number of Canadian laboratories for analysis in order to check up on the reliability of the methods used. The results from all laboratories were found quite satisfactory, from the point of view of commercial analysis, and several of the best were considered to be good enough even for classification purposes.

## Discuss Operating Problems At Northwest Assoc. Meeting

STUDIES of operating problems with a view to effecting economy in the operation of various parts of the system dominated the ninth annual general meeting of the Engineering Section of the Northwest Electric Light & Power Association of Portland, Ore., April 13 to 15. A registration of over 150, only slightly less than last year, was considered as a vote of confidence in the value of these annual meetings.

Operating experience with frequency and load control equipment on the system of The Washington Water Power Company was discussed by J. S.McNair, showing that the system frequency and time-regulation had been greatly improved and that the use of the load-controller with automatic transfer had improved the operating efficiency. It was suggested that further development and additional refinements will be necessary in order to apply automatic operators simultaneously at more than one point on an interconnected system.

J. C. Henkle, Portland General Electric Company, presented a study of the

comparative cost of rebuilding old transformers and replacing them with new by evaluating the improved efficiency characteristics of the newer designs. He concluded that replacement is more economical in the case of older transformers, showing by curves the allowable loss limit on various sized transformers beyond which repairs were unecomonical.

Another problem of growing importance to be given consideration at the meeting was that of diesel-electric generating stations in a paper by A. H. Greisser, Portland General Electric Company. Comparisons were made between efficiencies attained from fuel in this and other types of prime movers.

## No Bids Received On Brawley Diesel Plant

No BIDS were received by the City Council of Brawley, Calif., for a diesel engine power plant and municipal distribution system for that city. April 7 had been set as the date for opening bids. An expected bidder declined to bid on account of the unfavorable condition of the bond market. As a result, a resolution was adopted by the council closing the matter.

At the same meeting Melburn Mayock, a Los Angeles attorney, submitted a proposal that the city take over the distribution system of the Southern Sierras Power Company and make a contract with a corporation to be formed by him under which the latter would install diesel engines and lease the distribution facilities for a period of 25 years. This was taken under advisement.

## Minnesota Classifies Coals According to Smoke Produced

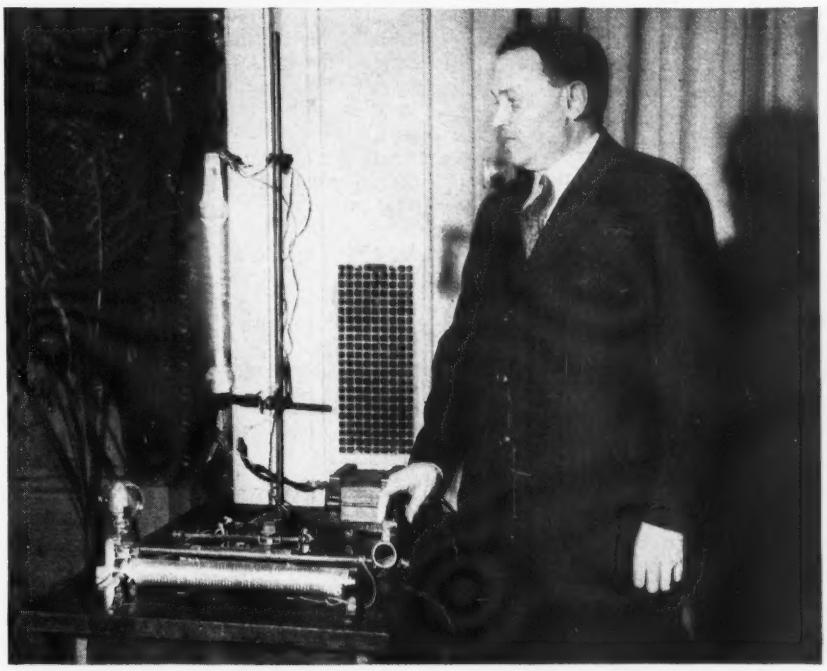
A NEW SET of regulations compiled by R. A. Trovatten, Minnesota Commissioner of Agriculture, has been issued to all coal dealers in the state, in connection with the commissioner's drive to eliminate alleged fraudulent advertising of coal.

The regulations classify coals with respect to the amount of smoke resulting from their combustion as coals of low volatility and high volatility, and define "smokeless" coals as being only either hard coal or coke. Lignite is not to be considered smokeless; and only anthracite and coke may be sold as "sootless."

Low-volatile coals or classified as anthracite, semi-anthracite and semi-bituminous; and all other varieties as high-volatile coals.

By the new regulations, trade names may not be used in connection with the selling or advertising of coal unless they are accompanied by what is an accurate description of such coal or coke without the use of the trade name.

## NEW SODIUM LAMP IS 70% EFFICIENT



Dr. Harvey C. Rentschler, director of research of the Westinghouse Lamp Company, demonstrates the hot-cathode sodium-vapor lamp recently developed in Germany by Dr. M. Pirani, director of research of the Osram Company. It has an efficiency of 70 per cent, which is three to four times as efficient as neon light and gives six times as much light for the same current as the 40-watt tungsten lamp, due to the fact that practically all the radiation from the element sodium falls very nearly in that part of the spectrum most sensitive to the eye

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## Beauharnois Gets Financial Help From Government

FINANCIAL DIFFICULTIES of the Beauharnois Power Corporation, attributed to political machinations of the past year, were partially cleared up on April 18, when Premier R. B. Bennett issued a statement to the effect that the Government of Canada would guarantee the $7,957,000 advanced by Canadian banks against first-mortgage bonds on the works under construction and that the government is also prepared to advance $15,000,000 toward completion of the project, which is estimated to cost $55,000,000.

It is a part of the plan that some of the larger private investors in the enterprise and the banks will together furnish the remainder required. The government of Quebec will forego its right to $1,500,000 in taxes up to 1937, when the work should be completed for delivery of more than 1,000,000 hp., according to the statement by Premier Bennett.

But the Government of Canada will not guarantee the interest on $30,000,000 second debenture bonds defaulted April 1, he said. After July 1 the bondholders may take such action as they consider expedient.

The work has been declared for the general advantage of Canada and the government has proceeded on that basis. The men with shares obtained by alleged political influence have been eliminated and their stock surrendered. The Government of Canada has, therefore, succeeded in gaining control at a minimum of outlay and guarantee in a work which may be regarded as secured by contracts for power with the Ontario Hydro-Electric Power Commission and the Montreal Light, Heat and Power Company.

## El Paso Operating Dept. Extends Safety Record

POWER PLANT MEN of the El Paso Electric Company, El Paso, Texas, have established an outstanding record for safety in operation. Up to April 1, 1932, an average of 62 employees worked a total of 427 days, or 210,616 man-hours, without a single lost-time accident. This beats the previous fine safety record of the power plant, when men in the department completed 415 days operation without a lost-time accident.

A. C. Learmonth, in charge of the power station department for the company, reports that, in addition to the fine record established by the department as a whole, the crew handling mechanical maintenance at the plant have rounded out three and a half years without an accident.

## J. B. Miller Dies, Chairman Of Southern Calif. Edison

JOHN BARNES MILLER, chairman of the board of directors and former president of the Southern California Edison Company, died April 14 in the Good Samaritan Hospital, Los Angeles, of blood-poisoning. He was a leader in financing large power developments in the West.

Born at Port Huron, Mich., on Oct. 23, 1869, Mr. Miller was graduated

from Ann Arbor High School and attended the University of Michigan for a year. Before going to Los Angeles in 1896, he studied law in Port Huron, was a planter in Louisiana and directed a steamboat and fuel business in Michigan. He was only 27 when he entered the employ of a small lighting company in Los Angeles, yet in five years he was head of the Southern California Edison Company, which he helped to organize by merging 40 small concerns into one.

Under Mr. Miller's direction, the Edison company completed the ten-year Big Creek-San Joaquin River hydro-electric construction project in the Sierra Nevada mountains, which involved the building of the famous Florence Lake tunnel; the construction of the world's first 220,000-volt transmission line; and the development of the Long Beach steam-electric generating station, one of the largest and most efficient in the country.

## Research and New Product Exhibit in Boston, May 3-4

NEW PRODUCTS of New England plants and research laboratories of Massachusetts Institute of Technology will be exhibited to business men and manufacturers on May 3 and 4, when the New England Council, through its industrial committee, will conduct "Research Day" and "New Products Day" for New England industries. This announcement was made at council headquarters in Boston April 18 by James W. Hook, chairman of the industrial committee.

On "Research Day," Tuesday, May 3, New England industrialists will have an opportunity to see how research operations of great interest to industry are carried on in seventeen different laboratories of M.I.T. The tour of laboratories will be made in groups, organized according to interests.

An open forum for discussion of the development, testing and marketing of new products will be the feature of "New Products Day," on Wednesday, May 4. This part of the conference will be held at Hotel Copley-Plaza, Boston, where displays of new products, promotional material, and market aids will be on exhibition. Manufacturers wishing to use this display space should notify the New England Council at once.

## COMING CONVENTIONS

**American Society of Mechanical Engineers.** Spring meeting at Bigwin Inn, Lake of Bays, Ont., Canada, June 27-July 1. Management, Maintenance and Materials Handling Congress at the Hotel Statler, Detroit, Mich., May 4-5. Oil and Gas Power meeting at Pennsylvania State College, June 8-11. Secretary, Calvin W. Rice, 33 West 39th St., New York City.

**American Institute of Electrical Engineers.** District meeting at Providence, R. I., May 4-7. Annual summer convention at Cleveland, Ohio, June 20-24. Heaquarters, 33 West 39th St., New York.

**American Boiler Manufacturers Association.** Annual convention at the Greenbrier Hotel, White Sulphur Springs, W. Va., May 23-25. Secretary, A. C. Baker, 801 Rockfeller Building, Cleveland, Ohio.

**American Society of Heating and Ventilating Engineers.** Semi-annual meeting at the Hotel Pfister, Milwaukee, Wis., June 27-29. Secretary, A. V. Hutchinson, 51 Madison Ave., New York City.

**American Refractories Institute.** Annual spring meeting at the Wm. Penn Hotel, Pittsburgh, Pa., May 18. Secretary, Dorothy A. Texter, Oliver Building, Pittsburgh, Pa.

**American Society for Testing Materials.** Annual meeting at Chalfonte-Haddon Hall, Atlantic City, N. J., June 20-24. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

**American Water Works Association.** Annual convention at the Hotel Peabody, Memphis, Tenn., May 2-6. Secretary, Beekman C. Little, 29 West 39th St., New York City.

**American Welding Society.** Annual meeting in New York City, Apr. 27-29. Secretary, M. M. Kelly, 33 West 39th St., New York City.

**Association of Iron and Steel Electrical Engineers.** Annual convention in Pittsburgh, Pa., June 20-24. Managing Director, John F. Kelly, Empire Building, Pittsburgh.

**National District Heating Association.** Annual convention at the William Penn Hotel, Pittsburgh, Pa., June 14-17. Secretary, D. L. Gaskill, Greenville, Ohio.

**National Electric Light Association.** Annual convention in the Atlantic City Auditorium and Convention Hall, Atlantic City, N. J., June 6-10. Secretary, A. Jackson Marshall, 420 Lexington Ave., New York City.

## Charles C. Moore, Engineer And Civic Leader, Is Dead

CHARLES CADWELL MOORE, organizer and president of Charles C. Moore & Company, engineers of San Francisco, died April 17 at his country home in Santa Cruz, Calif. A leader in the development of San Francisco before and after the fire of 1906, Mr. Moore was president of the Panama-Pacific International Exposition of 1915, a former president of the San Francisco Chamber of Commerce and a director of many Pacific Coast corporations.

Mr. Moore was born in Alpine, N. Y., July 12, 1868, and was brought to California by his parents, when an infant. He was graduated from St. Augustine College, at Benicia, Calif., which is no longer in existence. From 1885 to 1895 he was employed by the San Francisco Tool Company and in the latter year he took over a major interest in the business. The firm became Charles C. Moore & Company, engineers, and was incorporated in 1902.

Under Mr. Moore's direction the firm built many power plants, of which perhaps the most important was the Redondo Beach steam station, completed in 1908. This plant was one of the first to make use of automatically controlled oil firing, and as a result of the economy achieved Mr. Moore's company received the largest bonus paid up to that time under a steam power plant efficiency guarantee.

## W. C. Baylies Elected Boston Edison President

WALTER C. BAYLIES, for many years senior vice-president of the Edison Electric Illuminating Company of Boston, Mass., was elected president April 18 to succeed the late CHARLES L. EDGAR, who died at Atlantic City, on April 14. At the same time FRANK D. COMERFORD, president of the New England Power Association, was elected to the Edison company's board of directors.

## 400,000-Hp. Development in Manitoba Believed Feasible

DIVERSION of the course of the Saskatchewan River to provide for a 400,000-hp. hydro-electric development in northern Manitoba now appears more feasible than ever, the Minister of Natural Resources told the Manitoba Legislature recently. Survey parties were at work in the area all last summer and other parties will be sent out shortly. The project involves the diversion of the flow of the river southward through Lake Manitoba and thence to Lake Winnipeg and the creation of a number of new lakes.

# Personals

JOHN C. PARKER, president of the Brooklyn Edison Company, has been elected representative of the electric light and power group on the board of directors of the American Standards Association. He succeeds MATTHEW S. SLOAN, whose term on the board expired last December. Mr. Parker has been a member of the A.S.A. Standards Council, representing the American Institute of Electrical Engineers for several years, and was vice-chairman of the council for 1931 until his resignation last month.

COL. GEORGE H. FENKELL has been selected to represent the Detroit Engineering Society on the American Engineering Council. He succeeds Major GARDNER S. WILLIAMS, deceased. Colonel Fenkell is general manager and chief engineer of the Detroit Department of Water Supply. He has had extensive water works experience in various parts of the United States.

F. J. CORNFORD, formerly construction superintendent of the Ohio Power Company, Philo, Ohio, is now construction engineer for the Scranton Electric Company at Pittston, Pa.

P. J. OST, who served the City of San Francisco as its chief electrical engineer, has taken a similar position with the Public Utilities Commission of the city.

# Obituary

WILLIAM PRELLWITZ, chief engineer of the Ingersoll-Rand Company, at Phillipsburg, N. J., with which he had been associated since 1892, died April 12 in a hospital in Easton, Pa., following an operation. Mr. Prellwitz was born 62 years ago in New York City, where he graduated from Cooper Union as a mechanical engineer. He went to Phillipsburg when the Ingersoll-Rand Company established its plant in that city. He was a member of the American Society of Mechanical Engineers.

WILLIAM NEWTON AGNEW, traffic manager and assistant to the president of the Worthington Pump and Machinery Corporation, Harrison, N. J., died suddenly April 12 at his home in New York City. Mr. Agnew was born in Seymour, Ind., April 26, 1876, and received his education in the schools of Cincinnati, Ohio. Sensing the possibilities of the industrial side of railroading, then in its infancy, in 1901, Mr. Agnew joined the Durant Dort Carriage Company, Flint, Mich., as traffic manager. In 1910, he became traffic manager of the International Steam Pump Company and succeeded to the same position upon the organization of the Worthington Pump and Machinery Corporation in 1916. In 1929 he became also assistant to the president.

## How's Business?

THERE IS a slight, belated touch of spring in some of the recent business statistics, in spite of the solid frost of fear and defeatism in the financial atmosphere. In most of the important indicators, allowing for the usual seasonal factors, the discouraging decline of recent months seems to have stopped, and in some a slight improvement has appeared. Steel activity, especially in the independent concerns, is being sustained by a slowly rising stream of automotive orders. Electric power production (1,480,738,000 kw.-hr. for the week ended April 16, according to the N.E.L.A.) appears to be straightening out to a stabilization level, and building contracts likewise are supported by some improvement in public construction work as the season opens. — *The Business Week*, April 27.

# Business Notes

COOPER-BESSEMER CORPORATION, Mt. Vernon, Ohio, has appointed T. F. Hudgins general sales manager to succeed Fred H. Thomas, who died on March 27. Mr. Hudgins has been vice-president and Western sales manager, in charge of all sales west of the Mississippi River.

NORTHERN BLOWER COMPANY, Cleveland, Ohio, announces the addition to its staff of Karl Gross, one of the leading authorities in this country on lead burning, lead coating and homogeneous lead work. The company states it is now in a position to quote on any kind of lead work.

ERNST & COMPANY, Newark, N. J., has appointed Johnson and Kuechler, Inc., 30 Church St., New York City, as sales representative.

STARKWEATHER ENGINEERING COMPANY is the new name of Starkweather & Broadhurst, Inc., of Boston, Mass. This entails no change in location or officers, the company states, and the same field of power plant engineering and contracting will be covered.

F. H. NILES, president of the Wickes Machinery Company, is continuing the business recently discontinued by that company as manufacturers agents, appraisers, liquidators and dealers in machine tools, power and contractor' machinery. Offices have been established at 880 Bergen Ave., Jersey City, N. J.

ALCO PRODUCTS, INC., New York City, has opened a new branch office in the Rialto Building, San Francisco. This office is under the charge of R. S. Danforth, whose territory includes all of California.

HOLLUP CORPORATION, Chicago, Ill., announces the opening of a new factory at 5701 Green St., Emeryville, Calif., where welding machinery, electrodes and accessories will be manufactured for Pacific Coast distribution. E. J. Shuler is manager of the Western division.

GRAVER TANK & MANUFACTURING CORPORATION, East Chicago, Ind., announces the appointment as general sales manager of W. K. Evans, who has been associated with the Shell Petroleum Corporation for the past eleven years.

# Trade Catalogs

ENGINEERING SERVICE—An illustrated book just issued by Stone & Webster, Inc., 90 Broad St., New York City, records the history of that organization and its services to industry and science from 1888 to 1932. A chart sets forth, for the first time, the working relationship between the parent company and its various subsidiaries, which function as a unit in a broad field embracing engineering construction and finance and the ownership and supervision of public utilities.

DEAERATING EQUIPMENT — Means and methods for combating oxygen corrosion of boilers, piping and other apparatus in buildings are the subjects of a new publication, No. 1810, distributed by the Cochrane Corporation, 17th and Clearfield Sts., Philadelphia, Pa. The booklet describes and illustrates equipment for heating, deaerating, softening, storing and metering water. Cost analyses are also given.

DRAFT GAGES—Catalog PGA-32, just issued by the Hays Corporation, East 8th St., Michigan City, Ind., contains generously illustrated descriptions of indicating and recording gages for draft, pressure, differentials and temperature. Full specifications and construction details are included.

HEAT EXCHANGERS — Construction features of Vogt heat exchangers for various types of service are described and illustrated in Bulletin HE-2 recently published by the Henry Vogt Machine Company, Louisville, Ky. Shell and tube exchangers and multitube pipe exchangers are shown in detail.

WATER LEVEL RECORDERS—Bulletin No. 112, just issued by the Bailey Meter Company, Cleveland, Ohio, outlines the advantages, mechanical construction and various methods of installation of the Bailey boiler water level recorder. The bulletin describes the method for obtaining records of the true water level throughout the full range of the drum, and contains many installation photographs and reproductions of actual chart records.

# NEW PLANT CONSTRUCTION

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

**Calif., San Francisco**—Constructing Quartermaster, Fort Mason, having plans prepared for a group of buildings including 40 hp. high pressure boiler plant and two 400 gal. kettles. Estimated total cost $165,000.

**Calif., Sunnyvale**—Bureau of Yards & Docks, Navy Department, Washington, D. C., received lowest bid for boiler plant improvements from F. W. Snook Co., 596 Clay St., San Francisco. $83,627.

**Conn., Hartford**—Hartford Electric Light Co., 266 Pearl St., plans extensive conduit construction. Estimated cost $300,000. Work will be done by owner's forces. Unemployment project.

**Ill., Chicago**—1933 Century of Progress, having plans prepared for waterworks pumping station and sewer facilities to serve area of Century of Progress exposition grounds from 13th to 23rd Sts., also underground conduit system.

**Ill., Elgin**—City, c/o V. H. Kasser, City Engr., will soon receive bids for construction of centrifugal deep well pumping units at Lavoie & Schuler St. Cont. D., also changes at St. Charles St. pumping station in order to aerate and repump water from Levoie Ave. well including piping, valves, meters, and appurtenances, two well houses and all electrical equipment. Alvord, Burdick & Howson, 20 North Wacker Drive, Chicago, are consulting engineers.

**Ill., South Chicago Heights**—City plans construction of a sewage disposal plant including pump house, filter beds, etc. Allen. Fox, 1711 Halstead St., Chicago Heights, is engineer. Maturity depends on tax collection.

**Ia., Grand Junction**—City rejected bids of March 8 for construction of a 37 x 47 ft. light and power plant including two 265 hp. Diesel engines, two 185 and two 170 kw. electric generators direct connected to Diesel engines; complete distribution system. Estimated cost $85,000. Will hold new election. O. V. Blaylock, clerk.

**Md., Baltimore**—Board of Awards, will receive bids until May 4 for construction of a 7 story hospital building including steam heating and ventilation systems, etc., at 4940 Eastern Ave. Estimated cost $1,200,000. Palmer & Lamdin, 513 North Charles St., are architects. Van Rensselaer Saxe, 217 North Calvert St., is engineer.

**Mass., Boston**—Hospital Department, awarded contract for improvements to power plant at City Hospital, to John Bowen Co., Inc., 129 Newbury St., $208,700.

**Mass., Westfield**—Gladwin & Lane, 224 Elm St., awarded contract for construction of a 1 story, 60 x 100 ft. ice manufacturing plant to L. D. Phillips Construction Co. Inc., 10 Main St., Westfield. Estimated cost $40,000.

**Mich., Detroit**—Treasury Department, Office of Supervising Architect, Washington, D. C., awarded contract for construction of a boiler house, immigration station, also remodeling quarters, etc., to Misch Bros., 3001 Gratiot Ave., Detroit. $34,000.

**Minn., Morris**—City has engaged Robert J. Torrens, Shubert Bldg., St. Paul, Consult. Engrs. to make study and design municipal power plant and whiteway.

**Minn., Red Wing**—City Council has retained Robert J. Torrens, as consulting and designing engineer for power plant to be erected to serve city. Estimated cost $800,000.

**Minn., St. Paul**—State Building Commission, Henry Rines, Secy., 308 Capitol, awarded contract for furnishing and installing additional generator unit for power plant at State Capitol to A. R. Robertson Co., 1603 University Ave. $34,015.

**N. J., Clifton**—Forstman & Huffman Co., 2 Barom Ave., Passaic, having plans prepared for construction of two 1 story boiler house plants at Lake and Randall Aves., here. Estimated cost $40,000. M. Heiser, 2 Barbom Ave., Passaic, is engineer.

**N. Y., Brooklyn**—Department of Mental Hygiene, State Office Bldg., Albany, received lowest bid for heating work and power plant equipment at Brooklyn State Hospital here from A. D. Granger Co., 15 Park Row, New York. Total cost $124,776.

**N. Y., New York**—S. Haddock, 1133 Broadway, plans extensions and alterations to storage building including new boiler room, etc., at 51 Orchard St. Estimated cost to exceed $40,000. A. J. Simberg, 1133 Broadway, is architect.

**N. Y., Springfield** — Department of Water, Gas & Electricity, Municipal Bldg., New York, having preliminary plans prepared for alterations to waterworks pumping station here. Estimated cost $45,000.

**O., Ada** — Ohio Northern University, will move present engineering equipment to recently acquired plant of McCurdy Manufacturing Co. and is considering instalaltion. of electrical, mechanical, hydraulic, highway and materials-testing laboratories.

**O., Amherst**—Village, c/o C. A. Miller, Clk., plans alterations to light plant. Building will cost $10,000 and equipment $60,000. F. W. Straus, 2613 Queenston Road, Cleveland, is engineer.

**O., Cincinnati** — Cincinnati Union Terminal, Temple Bar Bldg., will receive bids until May 10 for construction of a coaling station and ash handling system. The coaling station will have an overhead storage capacity of 1,600 tons and will provide storage for 250 tons of wet sand and 50 tons of dry sand.

**Ore., Salem**—Board of Control, W. Einzig, Secy., Capitol Bldg., will receive bids until May 12 for construction of Sect. A, electrical distribution system to furnish light and power to buildings and institutions, Sec. B. complete power plant building at Penitentiary: Sect. C, installation of Diesel electric generating plant in power plant buildnig.

**Pa., Meadville**—City awarded contract for a 500 g.p.m. centrifugal pump and electric motor for water and light department to Ingersoll Rand Co., Meadville.

**S. D., Sioux Falls**—City, W. C. Layse, Auditor, completed plans for improvements to municipal power plant including installation of additional Diesel engine equipment. Estimated cost $85,000. Pillsbury Engineering Co., 1200 Second Ave. S., Minneapolis, Minn., is engineer.

**Utah, Ogden**—City Commission, is canvassing citizens as to attitude toward municipal power plant. Estimated cost $200,000. John C. Brown, is city engineer. City Commission is sponsoring plant.

**Utah, Morgan**—City plans construction of a 200 hp. Diesel engine municipal power plant. Estimated cost $20,000.

**Wis., Menomonee Falls**—Village, will soon award contract for waterworks improvements including pumping station, 1,500 g.p.m. motor driven automatic control pump, 500 g.p.m. motor driven centrifugal booster pump and mercury type water level pressure regulator. $25,000. P. L. Clark, Appleton, is engineer.

**Wis., Racine**—Board of Water Commissioners, awarded contract for construction of waterworks sub-station including complete equipment to General Electric Co., 230 South Clark St. $34,000.

**Ont., Midland** — Midland Arena & Curling Club, R. R. Wilson, Secy., will receive bids until May 15 for installation of artificial ice plant.

**Ont., North Bay**—North Bay Arena Association, L. S. Clark, Chn., 19 Main St. W., will receive bids about May 1 for construction of a 128 x 236 ft. arena including artificial ice plant. Estimated cost $85,000. R. Y. Angus, 8½ Main St., North Bay, is architect.

## Equipment Wanted

**Boiler—Kansas City, Kan.**—Board of Public Utilities, C. A. Lowder, Secy., will receive bids in May for water tube boiler for municipal light and power plant.

**Boilers, etc.—Cleveland, O.**—Board of Education, F. G. Hogen, Dir., will receive bids until May 9 for two new boilers, coal vault and smoke stack for Albert Bushnell Hart School at 7351 Broadway. Estimated cost $45,000.

**Electric Meters, Transformers, etc. — Cleveland, O.**—City, A. R. Bruggeman, Dir., will receive bids until April 29 for furnishing electric meters, instrument transformers, condenser tubes and ferrules.

**Motor—Cambridge** (Boston P. O.), **Mass.**—J. L. Gleason & Co., 207 Bent St., plans to purchase a 30 hp., 220 v., 800 r.p.m. Interpole d.c. motor.

**Pumping Equipment—Denver, Colo.**—Board of Commissioners, will receive bids until May 11 for electrically driven pumping equipment including four centrifugal pumps rating, 5, 10, 15 and 20 m.g.p.d. and four synchronous motors, rating 200, 400, 600 and 800 hp., also controls suitable for operation of motors in connection with proposed new reservoir at University Park.

**Pump and Engine—Shenandoah, Ia.**—City plans to purchase 300 g.p.m. turbine pump and 150 hp. Diesel engine and generating equipment in connection with waterworks. Contract awarded for artesian well.

**Pumps—Williston, N. D.**—City will receive bids until May 9 for a 900 g.p.m. high service pump, 2,000 g.p.m. wash pump, 800 g.p.m. and 400 g.p.m. low service pumps, etc., in connection with waterworks improvements. Former bids rejected.

**Pumps—Memphis, Tenn.** — U. S. Engineer Office, P. O. Box 97, will receive bids until May 6 for furnishing and delivering three 15 in. sand and gravel pumps for dredges Nos. 1401, 1407 here and Vicksburg, Miss.

**Stoker Equipment—Tacoma, Wash.**—Supervising Superintendent, of Construction, Veterans Hospital, Palo Alto, Calif., will receive bids until May 10 for stoker equipment under three 250 hp. water tube Berchfield boilers for Veterans Hospital here.

**Transformers, Meters—Durban, South Africa**—Electricity Supply Commission, will receive bids until May 16 for supply of one 175 kva. two 200/390 v. three ph. hp. 50 cycle indoor type transformers: also until May 19 for supply of quantity of 222c. single ph. 50 cycle electrical meters.

## Industrial Projects

**Calif., McCrory**—Associated Oil Co., 79 New Montgomery St., San Francisco, will soon award contract for construction of a lubricating oil plant at Avon, Contra Costa county. Estimated cost $250,000.

**N. J., Clifton**—Jacques Wolf & Co., 350 Lexington Ave., plans construction of a 2 story chemical plant on Lexington Ave. Estimated cost $40,000 Architect not announced. Maturity soon.

**N. J., East Rutherford** — East Rutherford Syringe Co., 75 Mozart St., completed plans for construction of a 2 story syringe manufacturing plant at 54 Mozart St. Estimated cost $50,000. J. T. Camlet, 26 Piaget Ave., Clifton, is architect.

**N. J., Hoboken**—Hoboken Land & Improvement Co., 1 Newark St., plans construction of a paper manufacturing plant at Monroe and Madison Sts. between 9th and 11th Sts. Architect not selected. Hinde & Dauch, 253 Water St., Sandusky, O., lessee.

**N. J., Newark**—Hoyt Bros., 100 Shipman St., awarded contract for an 8 story, 75 x 85 ft. addition to plant for the manufacture of extracts, foods, polishes, cosmetics, etc., to Fassler Construction Co., Hill St. Estimated cost $150,000.

**O., Youngstown**—Automatic Industries, Inc., C. W. Froom, will ouild addition to plant for the manufacture of game boards using metal pegs. Estimated cost $100,000.

**Pa., Erie**—Erie Casket Co., W. C. Kibler, Pres., 1001 Sassafrass St., awarded contract for a 2 story, 70 x 130 ft. factory to E. E. Austin & Son, 1919 Reed St. Estimated cost $40,000.

**Tex., Beaumont**—Magnolia Petroleum Co., plans reconstruction of refinery plant destroyed by fire. Estimated cost to exceed $150,000. Maturity indefinite.

**Wis., Milwaukee**—Lemke Electric Co., 635 North 8th St., plans to rebuild plant destroyed by fire. Estimated cost $40,000.

**Ont., Niagara Falls** — Carborundum Co., awarded contract for addition to factory to Gardney Construction Co., Welland, structural steel and iron to Reid & Brown Structural Steel Works Ltd., 63 Esplanade St. E., Toronto.

**Ont., Toronto**—Exide Batteries of Canada Ltd. 153 Duffeld St., awarded general contract for addition to plant to R. G. Kirby & Sons. Estimated cost $40,000.

**United Soviet Socialist Russia,** c/o Amtorg Trading Corp., 261 5th Ave., New York, N. Y., will construct during 1932 a plant for production of powdered and enamel paints, oil varnishes and dryers at Cheliabinsk in Ural district. Estimated cost to exceed $1,000,000. Work by technical aid contracts.